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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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Alphabetical Index to Advertisers, Page 8. Where to Buy It in the West, Pages 9, 10, 12.

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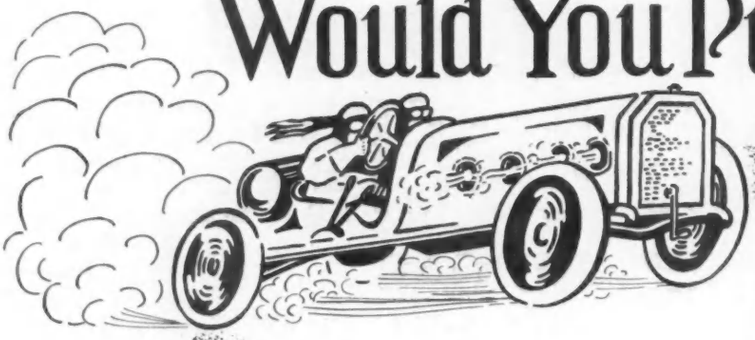

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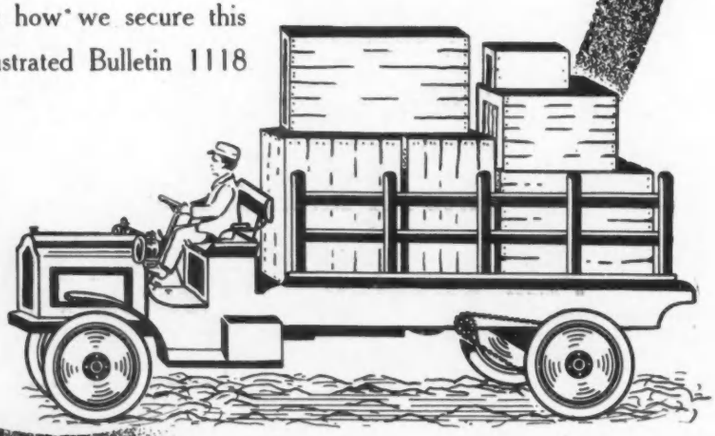

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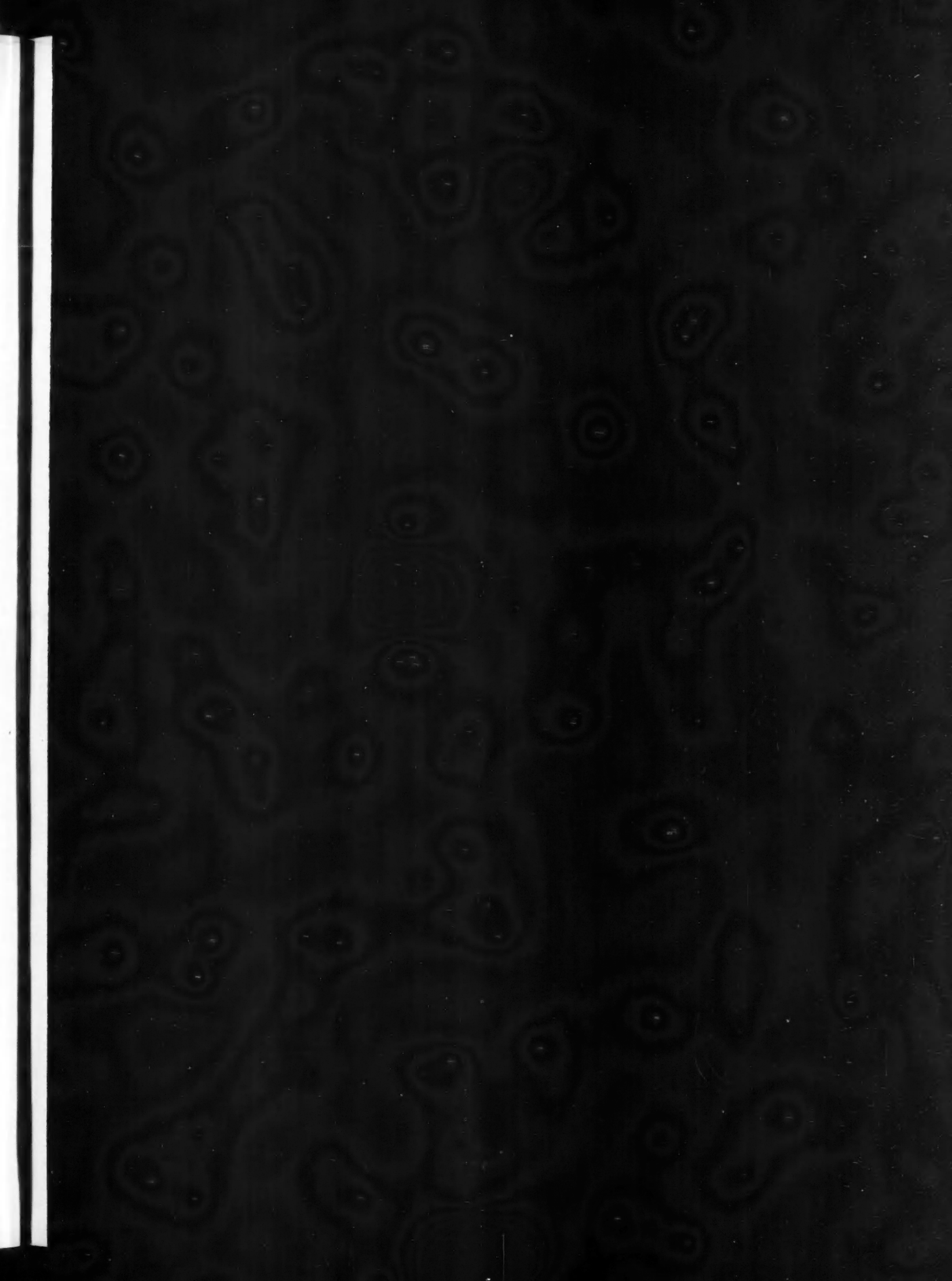

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VOLUME XXVIII SAN FRANCISCO, APRIL 20, 1912 NUMBER 16

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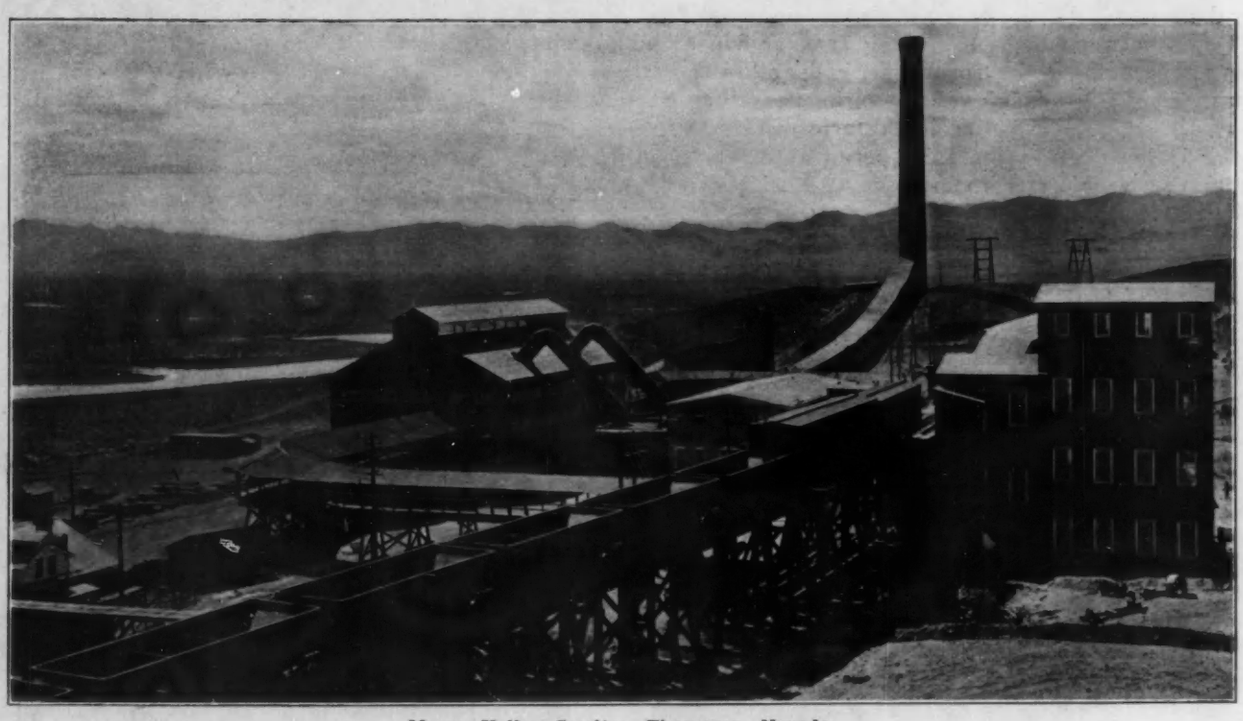
ELECTRICAL EQUIPMENT OF A NEVADA SMELTER

BY R. N. DAVIDSON.

A smelter depending wholly upon long distance electric transmission for its power, though not unusual, presents a number of interesting features. An hour's interruption in the power supply may mean an expensive freeze-up of furnaces. When it is considered how power lines are subject to winds, fires and lightning, as well as the occasional failure of some link in the long chain, at first thought such an arrangement might be criticized. However, with duplication of transmission lines, good construction and reserve capacity as at the Thompson (Nevada) smelter of the Mason Valley Mines Company, such a design is reasonably dependable.

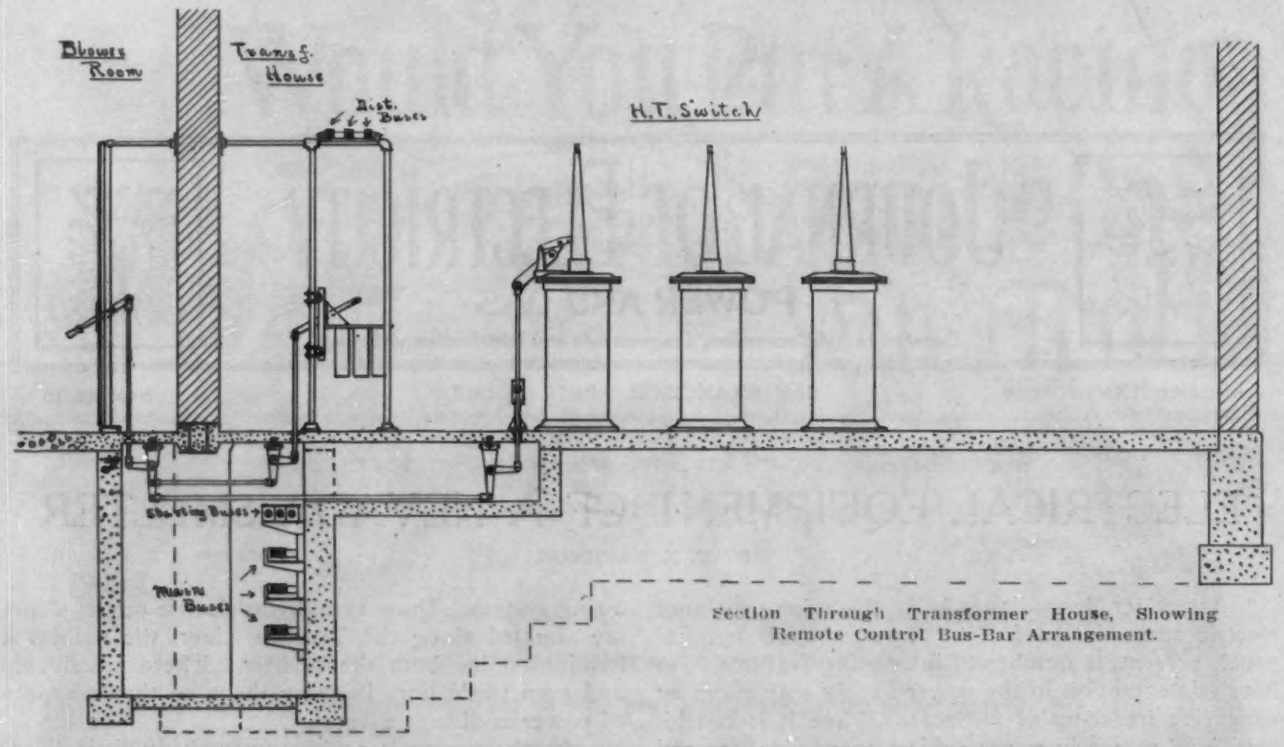


Mason Valley Smelter, Thompson, Nevada.

Power to a rated capacity of 1500 kw. is received at 66,000 volts over the lines of the Truckee River General Electric Company. Duplicate lines traverse different routes, and, as ordinarily operated, constitute a ring system. The several hydroelectric power plants are situated along the Truckee River, the nearest a hundred miles from the smelter. There are double and even triple lines between them, so that a supply of power is always assured.

As the region is arid, comparatively little lightning is experienced along the lines. These are substantially built, the form of support being double wooden cross-arms 26 ft. long on two 50 ft. cedar poles 12 ft. apart. The wires are hung from suspension insulators and the spacing is planned for operation at 100,000 volts. The poles also carry a pair of copper-clad steel telephone wires.

The poles' top switches control the smelter high voltage bus bars and are operated from within the transformer house. In case of trouble on one line the attendant, in touch with the Truckee River Com-



Section Through Transformer House, Showing Remote Control Bus-Bar Arrangement.

pany's dispatcher by telephone, can open the paralleling switch near by and then, by means of one or other of these two switches, get on the good line.

The location of the lightning arrester house and horn gaps on top of the transformer house allows a neat arrangement of the high-voltage wiring; and the openings through the roof inside the arrester house and behind the electrolytic tanks permit the warm air from the transformer room to ascend and keep the electrolyte from freezing.

Top Switches and Transformer House.

The transformer house itself is of brick with reinforced concrete roof supported on I-beams. The interior is whitened and all the high-voltage conductors are of copper tubing. These conductors are supported by regular line insulators of the pin type hanging right side up from stems of iron pipe and railing flanges bolted to the steel roof beams.

The current enters through compound-filled roof bushings to choke coils mounted upon the wall to a Westinghouse GA oil switch whose three tanks rest of the floor. The three 500 k.v.a. single-phase transformers are of the water-cooled shell type and are operated in delta on 66 kilovolts.

Single conductor cables, two 500,000 cm. in parallel, carry the 440-volt power down in front of the

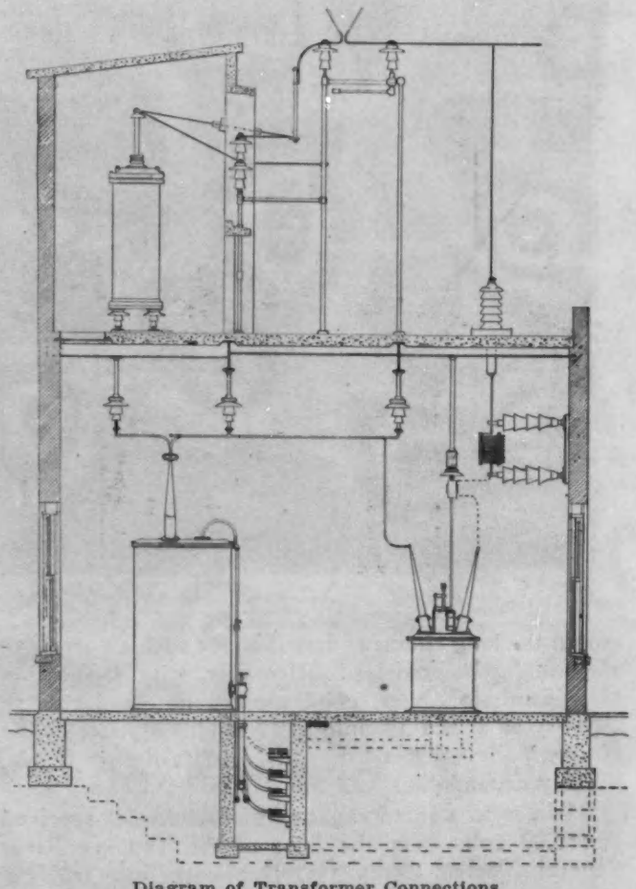


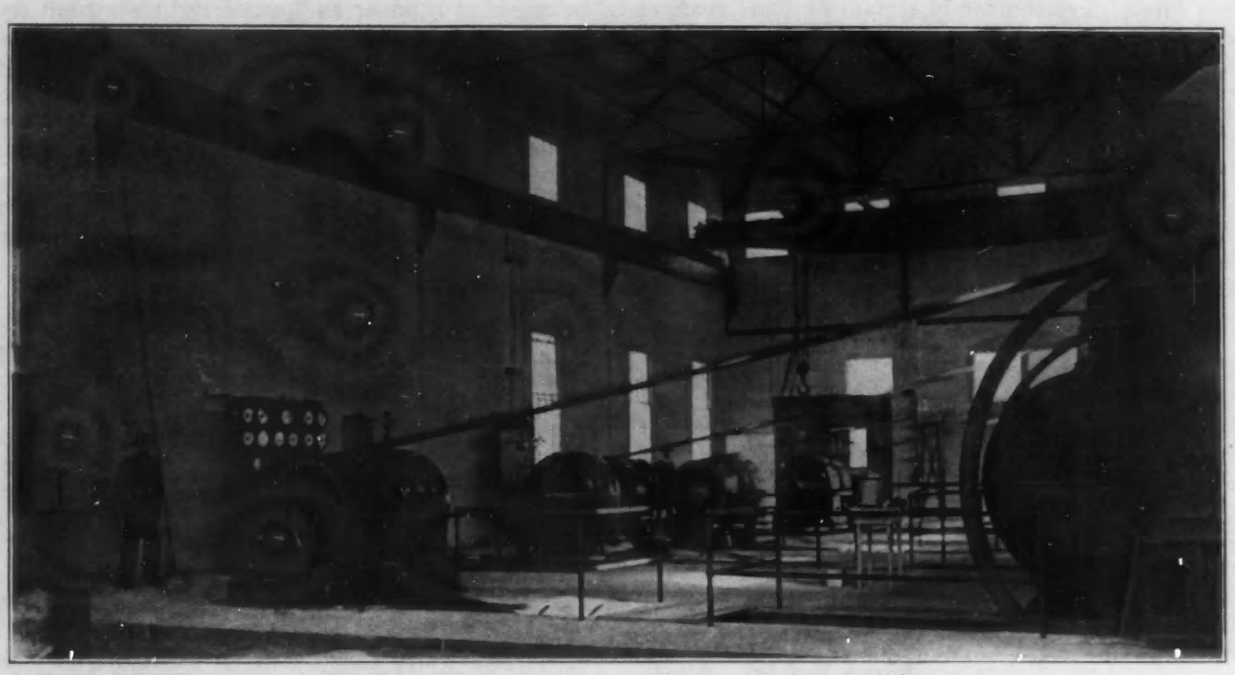
Diagram of Transformer Connections.

transformers in line with the piping for the cooling water into a subway to bus bars leading to the switch frame. This underground location of piping and busses gives a clear space in front so that to replace or repair one of the transformers it can be moved forward and out of the building without much delay.

Eighty per cent of the electric energy is consumed in the blowers and the location of the transformer house adjacent to the blower room allows the same attachment to care for both. The switch board is placed in the blower room on the opposite side of the wall from the switches which are in the transformer room and with which there is mechanical connection by means of rods and bell cranks.

at outlets the conduit itself is bushed down to the lead sheath with filled wood, except on the upper ends of vertical conduits outside, where GV pipe caps are used.

On the outside pole lines where the leads are heavy, two-post construction is used, and at corners four-post towers are built. On pole lines bare wire is used exclusively, being entirely on the company's property. It is considered that plain pole line hardware is superior to galvanized in a dry climate under the acid action of smelter fumes. For lighting both on smelter-site and townsite separate 440-volt circuits come out from the switch frame and transformers are hung on the poles to step down to the



Blower Room Showing Switchboard and Blower Units.

The blowing units consist of a Connellsville blower with a driving pulley on either end on each revolving element. They are accordingly driven by twin 200 h.p. slow speed motors belted and rotating in opposite directions. Theoretically, no power is transmitted by the gears as they serve only to keep the revolving pistons in proper relation. A 100 kw. motor-generator set with its own control board for the haulage systems is also along what may be called the electric side of the blower room.

Three low-voltage taps at corresponding points around the delta allow the main transformers to be used to start the motors in the blower room. Although this idea means three separate starting busses and one more conductor in the subway than if the usual open-V starting busses had been used, it compels each transformer to do its share of starting and is more flexible in case one transformer is disabled.

All conductors leading from the switch frame, both to blower room motors and to outside lines, are triple-conductor, rubber-insulated, lead-sheathed cable in iron conduit. Instead of expensive conduit fittings

110/220 volt three-wire system. One of the power circuits supplies the sample mill and the other has the remaining miscellaneous outside power such as three pumping stations, machine shop, carpenter shop, alternating current crane, clay mill and sintering plant.

Ore is conveyed from the storage bins to the blast furnaces in side-dumping cars drawn in trains of seven each by four-ton locomotives running on a twenty-four inch gauge track. This system is elevated on framed timbers and roofed over. The trolley is offset in order to pass behind the scale hoppers under the ore bins. It fastens directly to the roof structure above. The trolley wire for the locomotive which handles the slag larries below the blast furnaces is suspended on span wires between buildings. At the dumps it is supported by special brackets which are mounted so as to move with the track when it is shifted. The slag pots are dumped by a motor controlled by the motorman in his cab.

The general design of the transformer house is due to M. C. Godbe, of Salt Lake City, while the detail work and construction were in charge of the writer.

WESTERN LAWS OF ELECTRICITY AND WATER

THE LAW OF UNDERGROUND WATERS.

BY A. E. CHANDLER.

According to the Thirteenth Census the source of water supply for 433,630 acres of the total of 13,739,500 acres irrigated in 1909 in the Western States was wells. Of this area 332,410 acres were irrigated from wells in California, for which the total was 2,664,100 acres. Although the area so irrigated is but a small percentage of the total, it is constantly increasing. The surface supply is being rapidly exhausted and future development in certain sections must rest entirely upon the underground supply. This fact is so well recognized in California that the larger power companies have initiated a campaign of education to interest farmers in the use of electric power for pumping. They have installed a working exhibit on the University of California demonstration train and keep an expert in attendance to explain the operation of motors and pumps. The gas engine and pump manufacturers are equally interested and through their catalogues are making an effective argument for the introduction of pumping plants for irrigation.

There are two classes of natural underground waters—percolating waters and those that flow in a defined subterranean channel. Percolating waters have been well designated "vagrant, wandering drops moving by gravity in any and every direction along the line of least resistance."

Illustrations of underground waters moving in a defined channel are very familiar, and the so-called "sub-flow" of streams is especially common. In a former article the recent case of Miller v. Bay Cities Water Company was considered at some length. Although the court therein discusses the California cases on percolating waters, Miller's source of supply was clearly a "subterranean channel," and his right the same as that of a riparian owner on a surface stream. Waters in subterranean channels have always been considered subject to the same legal principles as the waters of surface streams. In most jurisdictions underground waters are presumed to be percolating and the burden of proving the existence of a known and defined channel is on the one so asserting.

The common law rule is that percolating waters belong to the owner of the surface and such rule is generally accepted except as later stated in this article. An early California case—Hanson v. McCue (42 Cal. 303)— adopts the rule in the following language.

> Water filtrating or percolating in the soil belongs to the owner of the freehold—like rocks and minerals found there. It exists there free from the usufructory right of others, which is to be respected by the owner of an estate through which a defined stream of water is found to flow. The owner may appropriate the percolation and filtrations as he may choose, and turn them to profit if he can.

It must be appreciated that the task of showing the difference between the two classes of underground waters in a given case is very difficult. It means the introduction of much expert testimony with the usual conflict in scientific views. An excellent illustration is the pioneer case of Los Angeles v. Pomeroy (124 Cal. 597) wherein the city sought to condemn land in the San Fernando Valley for use in connection with its water supply system from the Los Angeles River. The city contended that the waters under the surface of the tract in question composed the subterranean flow of the Los Angeles River and therefore belonged to it under its "pueblo right"—a right under the Mexican law giving the pueblo paramount interest in the waters of streams. Pomeroy claimed that such waters were but percolating waters and therefore belonged to him as owner of the soil. Very elaborate models and relief maps were introduced in connection with the expert testimony on each side and the court finally decided that the evidence showed the existence of a well defined channel and that the underground waters were therefore part of the flow of the Los Angeles River and not percolating waters.

California is the only Western State which has thus far departed from the common law rule of percolating waters. In the now celebrated case of Katz v. Walkinshaw (141 Cal. 116) the plaintiffs sought "to enjoin defendant from drawing off and diverting water from an artesian belt, which is in part on or under the premises of plaintiffs, and to the water of which they have sunk wells" for water for domestic purposes and for irrigating their lands overlying the artesian water. The defendant diverted "the water for sale, to be used on lands of others distant from the saturated belt." The plaintiffs contended that the subsurface water constituted an underground stream and that they were riparian thereto. The defendant on the contrary alleged that the water rising in her wells was percolating water and therefore her property. The original opinion of the Supreme Court in the case, written by Mr. Justice Temple, was handed down November 7, 1902. The court therein held that the artesian body was percolating water and not an underground water course to which riparian rights could attach. Instead of holding, as the lower court had done, that the defendant could not be enjoined, the Supreme Court after citing the authorities and dwelling on the difference in conditions "in a country like Southern California, where the relative importance of percolating water and water flowing in definite water courses is greatly changed," concluded that a different rule was required and established the new rule of reasonable use.

A rehearing was granted in order that additional arguments might be presented by those "not parties to the action, but vitally interested in the principle involved," and the final opinion, written by Mr. Justice Shaw, was handed down on November 28, 1903. The opinion is very important on account of its treatment of the common law, in addition to the modification of the law of percolating waters, as shown by the following extract:

The idea that the doctrine contended for by the defendant is a part of the common law adopted by our statute, and beyond the power of the court to change or modify, is founded upon the misconception of the extent to which the common law is adopted by such statutory provisions, and a failure to observe some of the rules and principles of the common law itself. In Crandall v. Woods, 8 Cal. 143, the court approved the following rule, quoting from the dissenting opinion of Bronson, J., in Starr v. Child, 20 Wend. 149: "I think no doctrine better settled than that such portions of the law of England as are not adapted to our condition form no part of the law of this State. This exception includes not only such laws as are inconsistent with the spirit of our institutions, but such as are framed with special reference to the physical condition of a country differing widely from our own. It is contrary to the spirit of the common law itself to apply a rule founded on a particular reason to a case where that reason utterly fails."

(It is a noteworthy point that the language of Mr. Justice Bronson quoted by Mr. Justice Shaw, was also quoted by Mr. Justice Ross in his dissenting opinion in Lux v. Haggin, wherein he argued that the common law rule of riparian rights, being unsuited to the existing conditions, should be rejected in California.)

After other forcible statements in regard to the adaptability and power of modification of the common law, the opinion describes at considerable length the semi-arid conditions existing in a large part of California ("in almost all of the southern half of it"), the insufficiency of the natural streams as sources of irrigation supply, and the absolute need of the utilization of the underground waters. Following the statement that "The claim that the doctrine stated by Mr. Justice Temple is contrary to all the decisions of this court is not sustained by an examination of the cases," it proceeds to analyze the former California cases supposedly upholding the common law rule of percolating waters, beginning with Hanson v. McCue, and concludes:

In view of this conflicting and uncertain condition of the authorities it cannot be successfully claimed that the doctrine of absolute ownership is well established in this State. It is proper to state that in all the opinions which have so readily quoted and approved the supposed common-law rule, that injuries from interference with percolating waters were too obscure in origin and cause, too trifling in extent, and relatively of too little importance, as compared to mining industries and the wants of large cities, to justify or require the recognition by the courts of any correlative rights in such waters, or the redress of such injuries, there has been no notice at all taken of the conditions existing here, so radically opposite to those prevailing where the doctrine arose. It is also to be observed that in some instances in the Eastern States, mentioned in the former opinion in this case, the injustice from the diversion of percolating waters has been so glaring and so extensive that the court there was compelled to depart from its previously decided cases and recognize the rights of adjoining owners.

The new rule established by the decision is well shown in the following paragraphs:

In controversies between an appropriator for use on distant land and those who own land overlying the water-bearing strata, there may be two classes of such land owners: those who have used the water on their land before the attempt to appropriate, and those who have not previously used it, but who claim the right afterward to do so. Under the decision in this case the rights of the first class of land owners are paramount to that of one who takes the water to distant land; but the land owner's right extends only to the quantity of water that is necessary for use on his land, and the appropriator may take the surplus. As to those land owners who begin the use after the appropriation, and who, in order to obtain the water, must restrict or restrain the diversion to distant lands or places, it is perhaps best not to state a positive rule until a case arises. Such rights are limited at most to the quantity necessary for use, and the disputes will not be so serious as those between rival appropriators.

Disputes between overlying land owners, concerning water for use on the land, to which they have an equal right, in cases where the supply is insufficient for all, are to be settled by giving to each a fair and just proportion. And here again we leave for future settlement the question as to the priority of rights between such owners who begin the use of the water at different times. The parties interested in the question are not before us.

Katz v. Walkinshaw has been consistently followed in all subsequent percolating water cases arising in California. As far as the establishment of further rules is concerned, the most important of the subsequent cases is Burr v. Maclay Rancho Water Company (154 Cal. 428) decided in 1908, as the question left undecided in Katz v. Walkinshaw was presented. The plaintiff therein "sued to enjoin the defendant company from pumping water from its wells on land adjoining that of plaintiff and transporting such water to distant lands for irrigation." The plaintiff's land consists of three tracts—blocks 153, 190 and 191 of the Maclay Rancho Ex-Mission San Fernando. The three tracts overly the body of percolating water. Plaintiff's wells are on block 191 which is an irrigated orchard. For a short time part of block 190 was also irrigated. The right is claimed for the irrigation of all of blocks 153 and 190 as well as the present irrigated block 191. Defendant's wells are on block 192 and while its pumps are being operated "it is impossible for the plaintiff to obtain any water from his wells by means of his pumps."

In the consideration of the case the Court comments on the contrast between the new doctrine of percolating waters and the rule of riparian rights in regard to true conservation as follows:

It is not the policy of the law to permit any of the available waters of the country to remain unused, or to allow one having the natural advantage of a situation which gives him a legal right to water to prevent another from using it, while he himself does not desire to do so. The established and settled law of riparian rights in running streams, which have become vested rights, may compel a different rule with regard to such waters in some instances, but these rules of law do not, of necessity control rights in percolating waters.

Certain headnotes used in reporting the case so well set forth the principles established that they are quoted in full:

Different owners of separate tracts of land, situated over common strata of percolating water, may, each upon his own lands, take by means of wells and pumps from the common strata, such quantity of water as may be reasonably necessary for beneficial use upon his land, or his reasonable proportion of such water, if there is not enough for all; but one cannot, to the injury of the other, take such waters from the strata and conduct it to distant lands not situated over the same water-bearing strata.

As between an appropriator of percolating water for use on distant land, and an owner of land overlying the water-bearing strata, who was using the water on his land before the attempt to appropriate, the rights of the overlying landowner are paramount. Such rights, however, extend only to the quantity of water that is necessary for use on his land, and the appropriator may take the surplus.

After an appropriator of water from a common water-bearing strata has begun to take water therefrom to distant lands not situated over the strata, for use on such distant lands, the owner of other overlying land upon which he has never used the water, may invoke the aid of a court of equity to protect him in his right to thereafter use such water on his land, and thus prevent the appropriator from defeating his right, or acquiring a paramount right by adverse use, or by lapse of time. Such an appropriation for distant lands is subject to the reasonable use of the water on lands overlying the supply, particularly in the case of persons who have acquired the lands because of these natural advantages.

As against the owners of such overlying lands, either those who have used the water on their lands before the attempt to appropriate, or those who have not previously used it, but who claim the right afterwards to do so, the appropriator for use on distant land has the right to any surplus that may exist. If the adjoining overlying owner does not use the water, the appropriator may take all the regular supply to distant land until such landowner is prepared to use it and begins to do so.

In controversies between the owners of such overlying lands, and an appropriator of the water for use on distant lands, the court has the power to make reasonable regulations for the use of the water by the respective parties, fixing the times when each may take it and the quantity to be taken, provided they be adequate to protect the person having the paramount right in the substantial enjoyment of that right and to prevent its ultimate destruction. In the present case the judgment is directed to be modified in accordance with these rules.

Although the new rule of percolating waters is now so firmly established in California, no other Western State has thus far adopted it, although the tendency seems that way. The Supreme Court of Idaho in Le Quime v. Chambers (98 Pac. 415) dealing with the appropriation of spring waters commented on the establishment of the new rule in California, but, as it considered the law of underground waters not necessary to the case before it, did not follow it. The Supreme Court of New Mexico in Vanderwork v. Hewes (110 Pac. 567) treated the new rule in the same way as the Idaho court. The Supreme Court of Colorado in Smith Canal v. Colorado Ice Co. (98 Pac. 940) after referring to Katz v. Walkinshaw, stated:

The law regulating ownership of percolating waters in the arid States is now of great—as time passes it will be still greater—importance; and, until a proper case is presented calling for it, we decline to announce the rule applicable to our local conditions.

As stated in McClintock v. Hudson (141 Cal. 275) the new rule regarding percolating water "makes it to a great extent immaterial whether the waters in this land were or were not a part of an underground stream" provided the withdrawal of such waters by defendant can be shown to substantially affect the source of supply—well or stream—of plaintiff. The need of distinguishing between the two classes of underground waters still exists in all the Western States except California, and in the latter the problem of proving the alleged damage to a source of supply remains and is generally a difficult one.

Contrast of the California Rules of Percolating Waters and of Riparian Rights.

The owner of land overlying a body of percolating water corresponds to a riparian owner on a surface stream, and an appropriator of percolating waters for use on distant lands (that is, not overlying) corresponds to an appropriator of surface waters for use on non-riparian lands. Under the rule of riparian rights the riparian owner may perpetually enjoin the diversion or storage of the waters of a stream when such diversion is or may be of injury to him; and in the consideration of the question of probable damages the riparian owner cannot be restricted to a reasonable use. Under the new rule of percolating waters the times and amounts of use by overlying owner and appropriator may be fixed by the Court so that the overlying owner will have the first use of a reasonable amount for his overlying land and the appropriator the surplus for the distant land; and in cases of present non-use by the overlying owner, the appropriator will be allowed to withdraw the water until the former is ready to use it. In brief, the new rule of percolating waters allows the widest possible use of the source of supply, while the rule of riparian rights results in waste. It is rather paradoxical to have the sub-surface supply, which is naturally conserved in the underground reservoirs, regulated by a wise rule, while the surface supply, which unless artificially stored or reasonably used must run to waste, remains unregulated.

In a former paper it was stated that the case of Lux v. Haggin fixed the modified doctrine of riparian rights in California seemingly for all time. This was so written as the general view, even among those strenuously opposed to the doctrine, is that the Supreme Court of California could not seriously consider the abrogation of the doctrine on account of the extensive rights which have been recognized as vested by the long line of decisions following the lead of Lux v. Haggin. It is believed, however, that the riparian rights of consequence to single proprietors belong to the Spanish grants; that the most of these have been long irrigated and therefore fully protected under the doctrine of appropriation; and that those that remain are being or will be subdivided into small tracts, comparatively few of which will retain the riparian right, and which will therefore be better served by the doctrine of appropriation. There remain in addition to the grants the public land subdivisions immediately touched or crossed by the streams, and which lie in such narrow strips that usually no feasible irrigation scheme can be made to include them without including non-riparian lands also—that is, without resting on the doctrine of appropriation. The abrogation of the riparian rule would therefore not materially injure single proprietors, the aggregate of whose holdings now seriously retards the promotion of storage works.

Lux v. Haggin fixed the rule of riparian rights for the reason that California had adopted the common law and that it was the doctrine of the common law. Katz v. Walkinshaw rejected the common law rule of percolating waters as unsuited to the conditions existing in California.

The court in Lux v. Haggin undoubtedly considered the riparian rule the best for the interests of the State, and looked upon the doctrine of appropriation as one certain to result in monopolies of the water supply. The present day view of this latter doctrine will be presented in the next article, and, it is believed, the "monopolistic" idea will be shown to be untenable.

COSTS OF ENGINEERING INSTRUCTION IN THE NORTHWEST.

An interesting paper was recently read before the Portland section of the American Institute of Electrical Engineers by W. A. Hillebrand, professor of electrical engineering at the Oregon Agricultural College. The paper deals with the problem of efficiency in teaching.

The data collected on costs per student-hour of instruction is unique and instructive.

In the courses given by the Department of Electrical Engineering at the Oregon Agricultural College there will probably be offered this year, seven thousand, three hundred (7300) student hours of instruction, or with a faculty of two and two-thirds men, for two instructors are shared by this and the Department of Physics, twenty-seven hundred and forty (2740) student hours per man. The imaginary schedule is admittedly light, which places our Oregon institution almost in the same class, as regards opportunity.

Since the question of efficiency in teaching is inseparably bound up with that of finance which provides the necessary funds, it should be of interest to ascertain, if only in an individual case, what the cost of instruction may be or actually is.

The courses offered by our department this year are as follows:

Junior	laboratory	course	2	semesters	2	credits each
"	recitation	"	2	"	3	" "
Senior	laboratory	"	2	"	2	" "
"	recitation	"	2	"	3	" "
"	design	"	2	"	2	" "
"	thesis	"	1	"	2	" "

In the Junior class there are eighteen men and in the Senior class eleven with a total of 7300 student hours and 413 credit hours, which totals cannot be deduced alone from the above table.

The cost of instruction is subdivided as follows:

Teaching salaries, labor and supplies used solely by the department in connection with the above enumerated courses	$4,325.00
College administration and maintenance, Electrical Department share	899.00
Fixed charges, interest and depreciation	1,360.00
Total	$6,584.00

Administration and maintenance cover the expenses of the executive, registrar and business offices, publications and care of grounds apportioned in the proportion of the number of students taking work in our department to the total registration. A better division would perhaps be founded on the proportion of student hours instruction to the total for the college, but these figures are not available. This item of expense also covers janitorial service and heating, apportioned in the ratio of floor space occupied by our department to the total floor space, estimated, of the college.

Fixed charges include interest at four per cent. This figure is the one used by Mr. Cooke in his report to the Carnegie Foundation. It seems legitimate to charge interest because the college plant was provided by the taxpayers of the State with funds which might otherwise be productive.

Depreciation is figured at the following rates: buildings 2 per cent; electrical equipment, 5 per cent; wire plant, property of college, 8 per cent; heating plant, 4 per cent; printing office equipment, 5 per cent.

a. Students enrolled in Electrical Department	30	
b. Total enrollment of full course students	1066	
Ratio, a/b is .0283, or 2.83 per cent.		
c. Floor space occupied by department	4,135	sq. ft.
d. Floor space, class rooms, laboratories and offices in Mechanical Hall, home of E. E. Dept	17,230	" "
Ratio, c/d is .25, or 25 per cent.		
e. Floor space for entire college (estimated)	353.000	" "
Ratio, c/e is .012, or 1.2 per cent.		

Fixed charges were computed and apportioned to the department as follows:

Mechanical Hall, 30,000 × .25 × (.02 plus .04)	$ 450.00
Departmental equipment, $8,500 × (.04 plus .05)	756.00
Campus lands, $15,000 × .04 × .0283	17.00
Power plant, $19,000 × (.04 plus .05) × .0283	48.00
Wire plant, $5,000 × (.04 plus .08) × .0283	17.00
Heating plant, $34,000 × (.04 plus .04) × .012	32.00
Printing plant, $5,500 × (.04 plus .05) × .0283	14.00
Administration offices, $5,500 × (.02 plus .04) × .0283	17.00
	$1,360.00

Although the estimated value of land on the campus is about $200,000, only the approximate purchase value was used in computing cost.

Ratio salaries, etc., to total cost	65.5%
Ratio administration and maintenance to total cost	13.6%
Ratio fixes charges to total cost	20.9%
Cost per student hour, $6,584.00 divided by 7,300 is $0.90.	
Cost per credit hour, $6,584.00 divided by 413 is $15.95	

For every registered hour a student spends with an instructor in our department it costs ninety cents. It is interesting to note that this value lies within the range reported by Mr. Cooke as the cost per student hour in physics at eight prominent Eastern and Middle Western colleges and universities. His costs average $0.87.

Assuming that the salary roll should vary about as the number of students, the cost of instruction may be represented by the following formula, where x equals the number of credit hours in courses offered by the department.

Annual cost, $2,259.00 + 10.50 × (10.50 equals salaries, etc., per credit hour in 1911-12). The amount which annually must be provided to run the department is given by the formula

$$899 + 10.50 \times + y.$$

where y is the annual equipment appropriation, which may vary from nothing to whatever the authorities feel can be afforded.

Doubtless the most perplexing question confronting every college president concerns the distribution of the annual appropriation. The author believes that a careful analysis of costs would be of material assistance in answering this question, and that, in general, a low cost per student hour will be a sign of inefficiency.

In striving for efficiency in teaching as in any other endeavor, we believe it necessary to possess a clear realization of the end sought, of the method which shall be followed and of the equipment and personnel required. Some conception of the necessary expense is also considered desirable.

PACIFIC COAST A. I. E. E. MEETING

The Portland meeting of the American Institute of Electrical Engineers which is just closing may easily be classified as one of the most interesting and profitable ever held in the West. Graced by the presence of Gano Dunn, president of the national body, the meeting drew forth many talented and eminent engineers of the West.

The following papers were presented:

"Operation of Two Alternating Current Stations Through Parallel Circuits and the Distribution of Load and Wattless Current Between Them," by J. W. Welsh.

"Air Gap, Flux Distribution in Direct Current Machines," by Charles R. Moore.

"Principles to Be Considered in Selecting a Water-Wheel Unit," by O. B. Coldwell.

"Irrigation in the Spokane Valley," by L. J. Corbett.

"An Underground System and a Few Developments," by S. B. Clark.

"Alternating Current Systems of Underground Distribution," by S. J. Lisberger and C. J. Wilson.

"Automatic Private Branch Exchange Development in San Francisco," by Gerald Deakin.

"Application of Automatic Selecting Devices to Telephone Multiple Switchboards," by Alfred H. Dyson.

"Plant Efficiency," by J. D. Ross.

"Practical Joint Pole Construction," by J. E. Macdonald.

"Design of Telephone Pole Lines for Conditions West of the Rocky Mountains," by A. H. Griswold.

"Arc vs. Tungsten Street Lighting in Small Towns," by C E. Stephens.

"Mechanical Results of the Use of Suspension Insulators," by V. H. Greisser.

"Long Distance Telephone Transmission on the Pacific Coast," by C. A. Turner.

The following is an abstract and summary of various papers presented:

SELECTION OF A WATER WHEEL UNIT.

BY O. B. COLDWELL.

The conditions which must be met with in the particular plant where the installation is to be made determine the general make-up of the unit. Water wheels may have but a single runner, may have a pair of runners, or for low heads, four or even six runners to the unit. In some places a vertical design of unit is required, while in others horizontal units best suit the conditions in many instances, it is merely a matter of taste, but in most cases there are features which influence the selection of horizontal or vertical units.

When a pair of wheels is used, it must be determined whether an outward discharge or a bottom center discharge is the more desirable. Both schemes are used, one involving a single draft tube, the other two draft tubes.

When low heads are met with, open flumes are possible and a properly arranged open flume may take the place of the closed flume. In high head work it is, of course, necessary to use a closed flume.

The housing enclosing the runners may have various forms. For instance, it can be a scroll case design or a cylindrical design; it can be made out of cast iron, cast steel or steel plate or may even be formed in concrete. The scroll case has high economy on account of the water passages being designed so as to give a proper increase in velocity before the water enters the runners.

There are many other types of flumes, such as the cone shaped type. This type has ordinarily high economy, but has the disadvantage of a bearing which is not readily accessible.

Consideration must be given as to whether the inlet of the unit is to be beneath the floor line or above; the general question of accessibility of the various parts of the unit, the location of the governor, and many other points must be given attention. Racks of ample area must be provided at the intake in order that there may be low velocities through same and little loss of head. The pipe line must have careful consideration and proper velocities must be selected.

In plants with long pipe lines, the speed regulation and the consequent pressure variation is of great importance, as the latter has to do with the strength necessary and, therefore, the design of the pipe line. In some cases, pressure regulators are necessary. Again, surge tanks may be used. The draft tube must have proper attention and the tail-race be such as to give low velocities. If the tail-race is restricted, the total head is affected.

In order that the purchaser and water wheel manufacturer may have at hand when the wheel is being designed data covering all of the points which should enter into the design, it has been thought advisable to give a list of questions which should be filled out as completely as possible by the purchaser and sent to the manufacturing company for use when making his wheel.

Data to Be Given to Water Wheel Manufacturer.

1. Number of units.
2. Horsepower of water wheels.
3. Kw. of generator.
4. Total head.
5. Open flume or closed flume.
6. If closed flume, what is number of pipes?
7. What kind of pipe?—wooden stave, steel or concrete?
8. Diameter of pipes.
9. Effective head (unless design of all water passages to and from wheel is left to water wheel manufacturer).
10. Head water elevation.
11. Floor elevation.
12. Tail water elevation.
13. Head variable, if so, what is normal operating head?
14. If head is variable, what is the range of variation?
15. How important is power and economy at lowest head?
16. Speed of generator, if already decided.
17. If speed of generator is not decided, name speeds which seem to purchaser most desirable and ask recommendations.
18. Flywheel effect of generator.
19. What speed regulation is desired for different load changes?
20. Will units run in parallel with other plants? If so, give general characteristics of such plants.
21. If running in parallel with other plants, can these plants be used to regulate the system?
22. What is the character of load factor?
23. What is the nature of water (silty or clear)?
24. What date shipment of material is desired.
25. Advise if it is expected that manufacturer shall furnish governor.
26. Give sketches of power plant site.
27. Give information as to what is to be expected in the way of guarantees.
28. Give any other information which you think would influence the design of the wheel.

It will not be attempted here to outline the specifications which should be made out to cover the purchase of the water wheel unit, but a list of data which should be supplied by the water wheel company is offered.

Data to Be Supplied to Purchaser by Water Wheel Manufacturer.

1. A check of the calculation on effective head.
2. Horsepower guarantee at normal head.
3. Guarantee at other heads, if head is variable.
4. Speed guarantee, including runaway speed.
5. Recommendation for best speed if same has not been determined.
6. Speed regulation guarantees.
7. Efficiency guarantees at full load, ¾ load and ½ load.
8. Point of greatest efficiency of wheel and value of same in per cent.
9. Efficiency guarantees for available head conditions.
10. If water wheel manufacturer furnishes governor, give information as to the type, make, power required to operate same, also what variation in speed will not be exceeded before the governor will begin to readjust gates to meet a change of load, either gradual or sudden.
    In what time will governor completely open or close gates? Within how many seconds will the speed of the unit be restored to normal?
11. Complete drawings showing machinery proposed.
12. Complete description of machinery proposed.
13. Guarantee of durability.
14. Guarantee of shipment.

ALTERNATING CURRENT SYSTEMS OF UNDERGROUND DISTRIBUTION.

BY S. J. LISBERGER AND C. J. WILSON.

In most cities where electric energy is distributed underground, particularly in congested sections, the Edison three-wire, 200-volt direct current sustem is used.

Comparison of Direct and Alternating Current Systems

Omitting considerations of first cost, the direct current system is preferable by reason of its simplicity and reliability; also, it is more flexible in operation.

Automatic regulators perform the same functions for the alternating current feeders that the several bus pressures do in the direct current system. The direct current system feeds into a common network, the feeders and mains being tied together through suitable junction and fuse boxes. The load on a direct current feeder rarely exceeds 300 kw., whereas an alternating current feeder, for economical distribution, carries ordinarily a load of 1000 kw. An alternating current feeder supplies a considerable number of mains, to which cross connection is made.

The secondary systems of alternating and direct current are similar in design. Due to the wide extent of territory covered by the feeder and mains, and to the large load connected to same, suitable emergency ties, junction boxes, oil fuses, etc., must be provided to sectionalize the portions of the system that may be affected, or upon which work must be performed. The necessity for these auxiliary devices is apparent when considering the high potential of the alternating current system as compared with the low potential of the direct current system.

Reasons for Adoption of Alternating Current Systems.

This paper is not intended to advocate the application of alternating current to an underground system as against direct current, but to present some reasons why alternating current must sometimes be adopted instead of direct current.

On the Pacific Coast many cities are supplied entirely or in part from hydroelectric transmission systems. In the inception current was distributed overhead at 2400 volts, two or three-phase, and transformed to 120/240 volts, single or polyphase, for light and power. A single substation supplied a wide area. Low rates induced the extensive application of alternating current apparatus. When city ordinances demanded the undergrounding of wires, operating companies were confronted with the problem of continuing the alternating current system or changing all the apparatus for use on direct current.

Financial considerations did not admit of a change of system. The necessity of building more substations, resulting in higher investment costs in lands, buildings, station equipment, storage batteries, and the expense of replacing consumers' apparatus, made the engineers reluctant to recommend the adoption of direct current. It should be borne in mind that the cost of installing storage batteries was prohibitive, and without battery standby the advantages of a direct current system were to a certain extent offset. The practice of competing companies was to install an alternating current system solely for reasons of first cost. Competition therefore demanded that alternating current be available.

Neglecting the question of competition, there is a growing demand for alternating current service, particularly for low-voltage sign lighting and other devices which can be used only on alternating current.

The authors in the foregoing have endeavored to outline why alternating current service must be supplied in underground territories. This paper will cover a description of this system as used in the territories supplied by the Pacific Gas & Electric Company. The discussions will not pertain to conduit or manhole construction, nor any details pertaining to types of cables used.

In certain territories both direct and alternating current are supplied for lighting and power purposes; in other territories where only alternating current is supplied for lighting and power purposes, direct current, for elevators and other types of apparatus demanding direct current, is supplied at 550 volts, no lighting being carried on this system.

The description following will apply only to the alternating current installation.

No fuses are used in the primary system, except on transformers, as practice has demonstrated that fusing of mains is unsatisfactory and further complicates the operation of the system. In two cities where we are supplying loads of 3000 kw. in a small congested district no trouble has been experienced on the general system during three years of operation, in which time faults have occurred on the secondary system, and in transformers, which were successfully cleared by the secondary fuses and the transformer oil fuses.

Conclusions.

Our experience with an alternating current system, the load on which aggregates 12,000 kw., has demonstrated that the system can be successfully operated. The design and operation of an underground alternating system, as compared with a direct

current system, should present no serious difficulties—provided, however, that suitable sectionalizing devices are obtained for use on the high-voltage parts of the system.

Safety to the workmen, and continuity of service, demand the use of more reliable apparatus on an alternating current system than is required on a direct current system.

Questions of comparative cost between the alternating and direct current systems have been purposely omitted, as the price of real estate, substations, and equipment will greatly affect the investment. The additional cost of sectionalizing devices for the alternating current underground system is small as compared with the costs of the direct current system. Load, service, and competitive conditions will be important factors in the choice of the system.

PLANT EFFICIENCY.

An Analysis of the Losses of a Hydroelectric System.

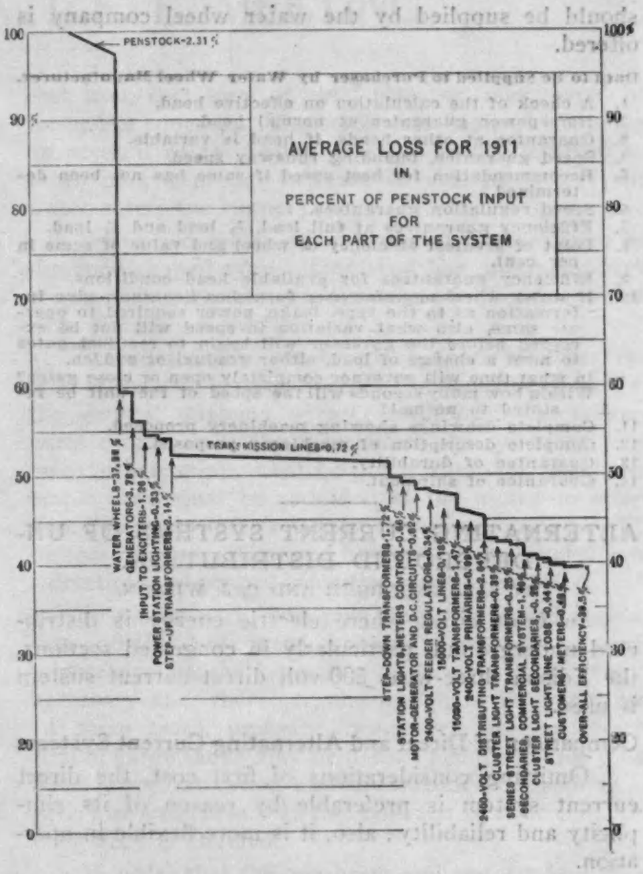
BY J. D. ROSS.

The following paper is an analysis of the losses and efficiencies of the Seattle Municipal Light & Power plant for the year 1911.

Great care has been taken in these measurements and the results have been checked in as many ways as possible and instruments have been frequently calibrated. These figures are therefore believed to be a close approximation to the true values.

General Description of Plant.

The Seattle plant is a hydroelectric system delivering water to two 1500 kw. Pelton units and two 5000 kw. turbine units under 600 ft. (183 m.) head through two pipes aproximately 3½ miles (5.6 km.) long, one of which is 67¾ (172 cm.) and the other 49 (124 cm.) inside diameter. The current is transmitted at 60,000 volts through two lines to Seattle, a distance of 38.7 miles (62.2 km.); and is there distributed at 15,000 and 2400 volts for use by approximately 20,000 customers and for the city street lighting.



OUTLINE OF LOSSES AND EFFICIENCIES FOR 1911, SEATTLE MUNICIPAL LIGHT AND POWER PLANT.

	Per cent all-day efficiency	Total 1911 input, kw-hr.	Average 1911 input, kw.	Total 1911 loss, kw-hr.	Average 1911 loss, kw.	Per cent loss	Per cent of penstock input	Per cent of total loss
GENERATING SYSTEM	54.4	52,639,000	6009	23,990,300	2739	45.6	45.6	75.3
Penstocks	97.7	52,639,000	6009	1,214,900	139	2.3	2.3	3.8
Generating station	55.7	51,424,100	5870	22,775,400	2600	44.3	43.2	71.5
Water wheels	60.7	50,758,900	5795	19,944,400	2277	39.3	37.9	62.6
Generators	93.5	30,814,500	3518	1,990,800	227	6.5	3.8	6.2
Exciters	....	665,200	76	665,200	76	....	1.3	2.1
Station lights and control	....	175,000	20	175,000	20	....	0.3	0.5
TRANSMISSION SYSTEM	91.6	28,648,700	3270	2,413,500	276	8.4	4.6	7.6
Step up transformers	96.1	28,648,700	3270	1,126,000	129	3.9	2.1	3.5
Transmission lines	98.6	27,522,700	3141	378,000	43	1.4	0.7	1.2
Step-down transformers	96.6	27,144,700	3098	909,500	104	3.4	1.7	2.9
DISTRIBUTING SYSTEM	79.2	26,235,200	2994	5,448,700	622	20.8	10.3	17.1
City substation	98.7	26,235,200	2994	346,400	40	1.3	0.7	1.1
S. Lights and control	....	317,400	37	317,400	37	1.2	0.6	1.0
Switchboard meters	....	....	....	29,000	3	....	0.1	0.1
15,000-volt system	92.5	11,587,000	1323	868,600	99	7.5	1.6	2.7
15,000-volt lines	99.2	11,587,000	1323	93,500	11	0.8	0.2	0.3
15,000-volt transformers	93.2	11,493,500	1312	775,100	88	6.8	1.5	2.4
Series street lights	86.3	2,672,800	305	367,200	42	13.7	0.7	1.2
Transformers	95.0	2,672,800	305	133,700	15	5.0	0.3	0.4
Series circuits	90.8	2,539,100	290	233,500	27	9.2	0.4	0.7
Cluster street lights	79.1	1,486,000	170	310,000	35	20.9	0.6	1.0
Cluster transformers	87.8	1,486,000	170	181,000	21	12.2	0.3	0.6
Underground cables	90.1	1,305,000	149	129,000	15	9.9	0.2	0.4
2400-volt commercial system	76.2	13,178,400	1612	3,123,700	357	23.8	5.9	9.8
Feeder regulators	98.6	13,178,400	1612	178,500	20	1.4	0.3	0.6
Primary feeders	96.0	12,999,900	1592	521,600	60	4.0	1.0	1.6
Transformers	88.8	12,478,300	1532	1,391,000	159	11.2	2.6	4.4
Secondaries	92.9	11,087,300	1373	782,600	89	7.1	1.5	2.5
Customers' meters	97.6	10,304,700	1284	250,000	29	2.4	0.5	0.8
Direct-current system	35.7	673,200	77	432,800	49	64.2	0.8	1.4
Motor-generator	38.0	673,200	77	417,000	48	62.0	0.8	1.3
D-C. circuits	95.0	256,200	29	12,800	1	5.0	....	....
Customers' meters	98.8	243,400	28	3,000	....	1.2	....	....

SUMMARY:

Total power loss	31,852,500 kw-hr.	Average 3,636 kw.
Total power delivered to customers	17,304,900 "	" 1,975 "
Total power delivered to street lamps	3,481,600 "	" 398 "
Total delivered power	20,786,500 "	" 2,373 "

Over-all efficiency, 39.5 per cent.

[1 kw-hr. at the customers' premises requires 1,364 gallons (5,163 liters) of water from Cedar Lake at average head of 590 feet (179.8m.)].

PRACTICAL JOINT POLE CONSTRUCTION.

BY J. E. MACDONALD.

The object of this paper is to set forth the Los Angeles method of joint pole construction, which five years of practice has proven to be a workable scheme.

Independent operation, accompanied by very rapid development and expansion, had permitted pole conditions to become extremely objectionable to the public as well as to the corporations responsible for them. This reached a critical stage in 1906, when agitation for underground subways for all public utilities marked the beginning of the present co-operative policy. Distribution by the underground method, except in the business district, is impracticable, for the reason that the populated districts demanding service are scattered over a very wide range of territory, there being entire absence of congestion anywhere.

The problem of joint pole construction was taken up for solution by the principal companies and the result was a general agreement covering the different phases of the work as seemed best fitted for local conditions. These conditions were favorable for the consummation of the project. The old construction stood out boldly as an object lesson in dangerous and unsightly congestion. The undeveloped but rapidly growing districts offered a field for trying the proposition under favorable conditions without any complications. There were some problems in the older districts which were not so readily solved, chief of these being difficulty of eliminating the capital charges against the existing overhead system of each operating company. It is evident that if any poles are removed before the expiration of their natural life, or if wires are transferred which are providing adequate service, then a certain portion of the original investment must be absorbed in some manner in reconstructing on joint poles. This factor was given proper consideration in the preliminary investigations made in arriving at a satisfactory working agreement. A policy was adopted making the participation in such joint construction entirely optional with each company. However, when any poles are set, it is always with a view to providing space for all parties operating in such location. Even with this liberal policy, there have been but few cases where all companies have not found it to their advantage and profit to immediately join in such construction. Notwithstanding this condition, there has been no unequal division of the financial responsibilities, neither has there been any reason to suspect that the joint work has helped the financing of one project at the expense of another.

The working agreement, which was executed by nine companies operating in common territory, assigned the executive powers to a committee, acting without compensation. This committee is comprised of one representative from each member company, all representatives having similar authority regardless of the pole plant owned by the company represented. A secretary, appointed by the committee, is actively in charge of the details of the combination work. An office is maintained independently of the affiliated companies, the expense being prorated uniformly against these member companies. The committee meets monthly for the discussion of combination work, and the consideration of mutual problems. The secretary is advised of all contemplated construction and reconstruction, and plans are made accordingly to provide for the service of all companies operating in the section, where proposed construction or reconstruction is to be undertaken.

The agreement makes certain fundamental stipulations; it defines the general purpose and intention of the agreement; it places certain necessary restrictions on joint work, defining the limits of good practice; it specifies the method of operating under the agreement; the term of agreement and responsibility of each company is predetermined as far as practicable; it limits the manner of occupying and space to be occupied by each party; it fixes valuations and charges, and prescribes regulations governing special expenses and maintenance.

In addition to the foregoing fundamentals, certain general regulations, which should not be considered as arbitrary rulings, have been adopted.

1. Combined Use of Existing Poles. In the combination use of existing poles, the combining parties use the highest or most satisfactory poles in the location where it is desired to make combination. The owner of same is permitted to bill the combining parties for a proportional interest at the rate which has been fixed for the valuation of such poles.

2. Reconstruction by Owning Parties. When it is desired to reconstruct a pole line in location where none of the existing poles are suitable for combination use, one of the parties operating in this location sets new poles of standard size and length sufficient for the combination use of all parties operating in this section and for any other party which may desire to obtain space on poles. The constructing or owning party then sells a proportional interest to each party making the combination at the rate which has been fixed for the valuation of such poles. Each party transfers its wires and removes its poles at its own expense.

3. Reconstruction by New Coming Party. When the party is occupying a favorable location on any street or highway, and a second party desires to build a pole line in the same location, if the construction of the first party is entirely satisfactory and adequate for present and future needs, that party is not obliged to assume any expense in connection with the joint occupation of the new pole line built by the second party. The latter builds pole line suitable for combination use of both parties, and grants and assigns an interest in same to the first party without charge, except that the first party transfers its wires, cross arms and fixtures at its own expense from old poles to new poles. This party removes its poles at its own expense and they remain its individual property. In special cases, however, the second party may be required to pay the entire expense incident to such transfer of wires and removal of poles, and this is determined by the committee, only those participating in the decision who are directly interested in the combination.

4. New Pole Lines in Undeveloped Territory. Any party desiring to construct a new pole line in location where heretofore no pole line has existed, no-

tifies the other members, through the committee, of the proposed construction, and upon request provides space on such poles for the use of all parties who express their intention of combining in their use. The constructing party is then permitted to bill each of the combining parties for a proportional interest at the rate which has been fixed for the valuation of such poles.

5. Renewing Poles Naturally Decayed. All poles which have been in use as long as the committee determines that they are safe or satisfactory, or as long as the parties owning shares in same desire to use them, are replaced by new poles. The work of constructing such new pole line is undertaken by one of the parties, as determined by the committee, and this party is permitted to bill the other parties in the same manner as specified heretofore.

6. Disposition of Joint Property Removed from Service. Joint poles removed from service may be removed at joint expense to a place designated by the committee, where they may be sold at auction, due notice having been given to each party prior to date of sale. The proceeds of the sale are divided between the owners in proportion to the number of shares owned by each. More frequently it is desirable that such poles should be sold or disposed of before being removed, the purchaser removing same at his own expense. This may be done by mutual agreement or by an exact division of the property in proportion to the shares owned by each party.

7. Use of Old Poles. In the combination use of poles, those which have previously been in service elsewhere may be used, and provided that such poles are in other respects equal to new poles, are valued at the same rate as for new poles of the same height except for that portion which has been in the ground, which is considered as of no value.

8. Records. A record map is prepared for all combinations. Poles are numbered to correspond with house numbers of adjacent property. These maps are supplements to the general agreement and furnish a complete record, specifying the number and size of poles, date when set, valuation, and such other data as may be desirable in each case. These supplements must be approved by all parties interested before any authorization for billing is permitted. A complete file of all combination work is maintained for each company by the committee.

9. Specifications. A specification is understood to imply only first class construction, and as a rule, deals with maximum and minimum quantities. Assuming, therefore, that each party is maintaining its lines in the highest state of efficiency, a joint specification is simply a summation of all specifications together with such modifications as are necessary to mutually protect the property of combining parties. This subject is so extensive that it cannot well be covered in a paper of this scope. The author would refer those seeking enlightenment along this line to the specifications adopted by the New York Telephone Company and the Public Service Corporation. This offers an excellent standard of construction, which is worthy of adoption. Local conditions will not demand any radical changes therefrom.

Progress in Los Angeles and Vicinity.

During five years of operation combinations have been recorded on 21,270 poles. By count of poles occupied by two or more parties it has been determined that the number which have been eliminated exceeds 30,000. The length of the average pole in combination use has been found to be 43.04 ft. (13.12 m.)

IRRIGATION IN THE SPOKANE VALLEY.

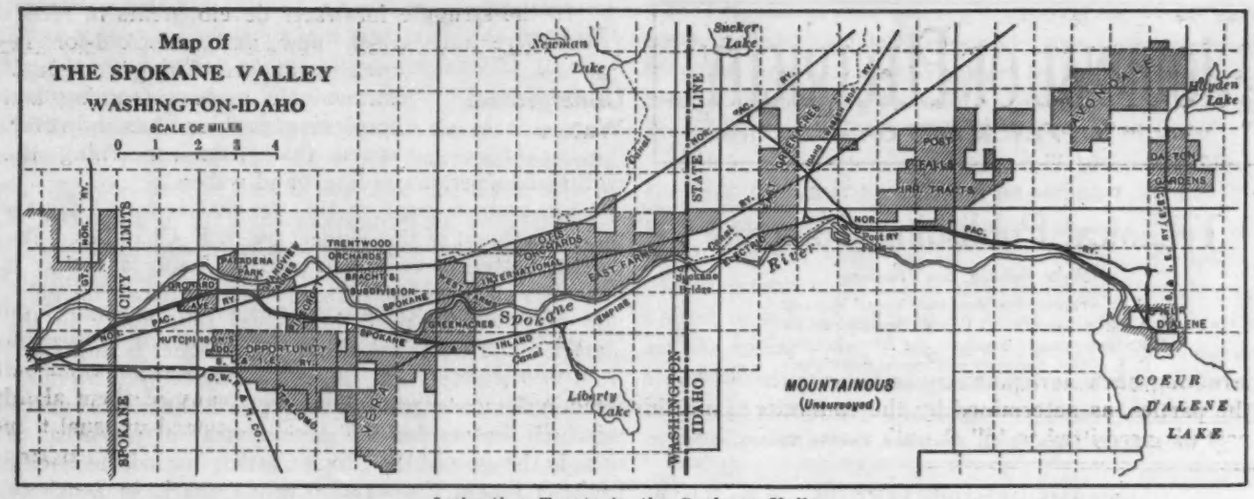
BY L. J. CORBETT.

The first time I made the trip through the Spokane Valley was on a hot July afternoon nearly twelve years ago. Most of it was dry pasture land, but here and there were fields of grain, many of them already cut, bound and shocked. This seemed unusual to me for that time of the year, for in my own neighborhood, some 80 miles (128 km.) south of this, the grain would not be ready to cut for some four weeks yet. Under these conditions it looked quite dry, parched and dusty. Houses were few and far between, and the bright sun shining on the whiteness of dry grass and stubble made the tree-covered hills at each side of the valley look far more inviting.

A July traveler of 1912 will see a far different view spread before him. He will pass orchard after orchard of peach, apple and pear trees, tracts of small fruits, vegetables and melons, and will see evidence of a plentiful supply of water on every hand. Neat, well built houses are dotted about over the landscape and the appearance of comfort, sociability, and thrift is general. This change has been wrought by irrigation, either by means of gravity systems or by electrically driven pumps. This pumping load is becoming of increasnig importance to the electric power companies.

The rate at present paid is $4.00 per kv-a. per month, subdivided into two fifteen-day periods, based on the ten-minute peak load. The irrigation load extends from May 1 to September 1; the remaining eight months the load consists of the lighting and the power for domestic water supply.

The cost of the plant in these cases is absorbed by the added value of the land. The land is sold in tracts, the unit being ten acres (4.05 hectares). With each acre of land, one share of stock in the water company is conveyed, so eventually, when the land is all sold, the owners of the land operate the water company as a mutual concern. The water contracted for is 14.4 inches (36.5 cm.) in depth in 120 days, commencing May 1. The water is to be delivered at the high point of each 10-acre (4.05-hectare) tract. The cost of operation and maintenance for the season of 1911 was about $6.50 per acre (0.405 hectare.) This does not include interest and depreciation. Exact data on the cost of these systems are not available. An average from the summary of an irrigation census, taken in 1910, places the average cost throughout the valley at $51.00 per acre. I believe that for these systems the cost would be higher than this, probably in the neighborhood of $80.00 per acre. This would include the cost of the domestic supply system, as would also the maintenance charge of $6.50 cover the cost of the domestic service. To allow for interest and depreciation, from $4.00 to $6.00 per year should



Irrigation Tracts in the Spokane Valley.

be added, which would bring the power cost up to from $10.50 to $12.50 per acre per year.

To give some actual figures, on a smaller project in the vicinity with which I was personally connected, the total amount of land was 330 acres (133 hectares), of which 20 acres (8.1 hectares) was granite scenery, upon which a number of tenacious pine trees clung. The well was located on low ground, where the total depth was only 46 feet (14 m.), the last 11 feet (3.3 m.) of which was below the low water level, and lined with a perforated steel casing, five feet (1.52 m.) in diameter. A wood tank located on the rocks acted as a standpipe and reservoir for the domestic supply, the head pumped against being about 190 feet (58 m.) including friction. A flat at an elevation of 35 to 60 feet (10.6 to 18.3 meters) above the water table, and a bench at an elevation of 100 to 110 feet (30.4 to 33.5 meters), were on one side of the well, while hillsides and benches up to 150 feet (45.7 m.) were located on the other side. In this project, one pipe system only was used for both irrigation and domestic water. The large pump is a 7-inch (18 cm.) two-stage turbine type centrifugal pump rated to deliver 1200 gal. (4540 liters) per min., or 2.66 second-feet (0.81 second-meters). It is direct connected to a 100 h.p. induction motor, three-phase, 60 cycles, 440 volts. A small triplex pump of 60 gal. (227 liters) per min. capacity, geared to a 5 h.p. motor furnishes the domestic supply for the eight months of the year in which irrigation is not practiced. A tunnelled recess was necessary on one side of the well to hold the equipment. This and the well were lined with concrete. Wood stave pipe, from 4 to 10 inches (10 to 25 cm.) in diameter, was used throughout the system.

The cost in this case, counting the amount already expended, and the estimate to finish, will amount to approximately, $16,000, or, distributed among the 310 acres (125 hectares), the plant cost is about $51.60 per acre.

The capacity in this case is less than in the case of the Opportunity and Vera plants before mentioned, being only one second-foot (0.3048 second-meter) to 116 acres (46.9 hectares), while the average for the other systems is one second-foot to 52 acres (21 hectares) and to 32.7 acres (13.23 hectares) for Opportunity and Vera respectively. In the small system, there has been no difficulty, as yet, on account of insufficient capacity, although the condition may arise when every acre is improved, that is; may be found expedient to add more capacity, but I think not. It was laid out for 16 hours of service per day.

On account of the high head pumped against, the power bills are high, though the interest and depreciation item is lower than on the other two systems. In this case the company makes a definite yearly charge of $12.00 per acre, though the estimate of cost had been $13.00.

The relatively high charges to the water user are not so serious in this locality as they might be in a district farther removed from large centers of population. It is possible for a workingman to live out on a small tract and work in Spokane, taking advantage of the interurban car service and commutation rates. He can have all the conveniences which go with water under pressure, he can have a reasonable amount of electric light free of extra charge, and can develop his land in his spare time. It is not a hardship on him then to pay a yearly charge of $6.50 for his one acre, for his water rent alone in the city would cost him from $9.60 minimum to $15.00 per year for the same conveniences. His electric light would add another minimum of $12.00 per year if he used it. His carfare on the interurban line would not be much greater than his carfare from any home he might have in the city, and the time taken by the trip would be the same.

For a man holding and developing a large number of acres the high charge would be more serious, but such matters adjust themselves from financial considerations, the most profitable crops for the large tracts being the perishable fruits, vegetables, etc., where the nearness to market is an important item and justifies the high cost of land and water. It would be a financial mistake to put the land in hardy apples, for instance, merely because of its nearness to the city.

As will be noted from the map, the valley is only about 35 miles (56 km.) long and an average of seven miles (11.2 km.) in width, so it is evident that in time the growth of the city of Spokane will encroach upon a large portion of it. At present, however, a variety of irrigation methods are practiced, and amounts of water furnished or prices charged are not uniform.

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CONTENTS

Electrical Equipment of a Nevada Smelter 349
By R. N. Davidson.

The Law of Underground Waters 352
By A. E. Chandler.

Costs of Engineering Instruction in the Northwest 355

Pacific Coast A. I. E. E. Meeting 356

Selection of a Waterwheel Unit 356
By O. B. Coldwell.

A. C. Systems of Underground Distribution 357
By S. J. Lisberger and C. J. Wilson.

Plant Efficiency 358
By J. D. Ross.

Practical Joint Pole Construction 359
By J. E. MacDonald.

Irrigation in the Spokane Valley 360
By L. J. Corbett.

Editorial 362
Underground Waters.
International Engineering Congress for 1915.
Load Factors.

Personals 364

Pacific Coast N. E. L. A. Train De Luxe 364

Seattle Jovians 365

Meetings of Pacific Coast A. I. E. E. Sections 365

Trade Notes 365

Industrial 366

News Notes 367

Underground Waters

In the struggle for water developments in recent years there have arisen new and unlooked-for intricacies in formulating their legal status. No more entangling and perplexing problem has, however, arisen than that concerning the rights of owners to underground waters.

On another page of this Journal is found a masterly treatment of this subject by A. E. Chandler. The entire matter is so recent and so important that it behooves all those interested in the electrical consumption of power to post themselves thoroughly in the matter. The electrical power plant owner is interested from two standpoints. First, he may himself be interested in the underground waters with the idea of utilizing such waters for the development of power as is done in the case of the Stone Castle plant of the Pacific Light & Power Corporation near Ontario in Southern California. In this case the underground waters of San Antonio Canyon are tapped by means of an extensive tunnel and the waters utilized for power development before they are applied to irrigation.

The other cause of intense interest to the power plant owner is that of the pumping of underground waters for the irrigation of small farm tracts. Literally, millions of electrical horsepower will some day be used in the West in pumping such waters upon small tracts of land in our arid Western empire. The power plant owner should be ready to instruct the farmer as to proper legal procedure to protect the farmer in his underground water development, for upon such safe and secure protection largely depends the consumption of these enormous powers.

The present status of water right decisions in California makes it imperative for security to purchase all riparian water rights along a stream and below a storage project to insure one against possible future damage suits. Such a situation is not only alarming, but if the courts cannot soon come to the relief by more liberal interpretations a serious drawback in development may result.

The decisions relating to the legal status of underground waters seem so just, so liberal, an impetus is now given for development of underground waters on a large and extended scale. It is to be hoped that such liberality and justness in decision may soon find its place in the courts relative to water rights.

The International Engineering Congress for 1915

For two solid hours President Dunn of the American Institute of Electrical Engineers held the San Francisco Section spellbound with his recent interesting description of the good things in store and the preparations being made for the international electrical congress to be held in San Francisco in 1915. The personnel of committees appointed speaks success in itself.

Some weeks back there appeared in the columns of the Journal a copy of the memorial sent by the temporary committee in charge of the proposed international engineering congress for 1915 to the great national engineering societies. The American Institute of Electrical Engineers took immediate and posi-

tive action and has assured the other societies informally that it stood ready to join with them for the gathering of the greatest congress ever attempted. Having assumed upon its own shoulders the complete responsibility for the successful outcome of the international electrical congress, the institute has decided—and wisely, too—that it should not take the leadership in the arranging of the general engineering congress.

Local members of the American Society of Civil Engineers are feeling justly hurt over the apathy of the executive officers of their society at New York in refraining thus far from taking affirmative action in this important matter. The Panama-Pacific Exposition is to be held primarily to celebrate the completion of the greatest civil engineering project of history, and local members of the A. S. C. E. feel their society should take the lead, by all odds, in this important matter after hearing of the enthusiasm displayed by the A. I. E. E. as depicted in the address of President Dunn, then comparing this live action with the inert attention of the A. S. C. E., even though their secretary did visit these parts recently, several prominent members of the A. S. C. E. were indignant, to say the least, over the slight evidently intended from the New York office.

The Pacific Coast today presents the most promising field for future growth in our great national engineering societies. It would seem a pity to have some of these Western men withdraw to form their own organizations where reasonable attention and courtesy could be expected for the needs of a growing country, but our great West is too big and too promising to allow inattention to retard its natural growth.

Load Factor

The paper submitted by J. D. Ross on "Plant Efficiency" at this week's Portland meeting of the A. I. E. E. contains many items of interest. It is the study of the efficiency of the plant as a whole which goes toward determining the dividends for the stockholders. Efficiencies can only be bettered by segregating the many details which make up the complete installation. Finally, this information together with the load factor of the system has much to do in determining an equitable basis of rates.

In order that this load factor may be determined, however, it is first necessary to have a clear and concise definition of what we mean by such a term. An important paper on "Municipal Electric Lighting Systems" by Professor C. L. Cory appeared in the columns of this publication in the issue of December 2, 1911. It was demonstrated conclusively that the load factor does play a most important role in the basis of rate fixing. For instance, it was shown in a particular case that the same return is realized from a given invested capital when power is sold at 2.57c, 3.4c or 6.32c per kw. hour, depending upon whether the load factor is 100, 70 or 35 per cent. A number of boards of supervisors as well as rate-making boards on the Coast have recently discussed this paper and it has been necessary to point out just what is meant by load factor. The term is a confusing one and should have but a single meaning.

In some quarters the load factor is taken to mean the total kilowatt hour output of a plant over a period of a year, divided by the continuous capacity of the plant over the same period. By continuous capacity is understood to be the actual power that can be generated in a hydroelectric or other generating station for the entire year. This, of course, would depend on the water situation during various months of the year. So far as rate making is concerned, this definition has no application.

Still another definition of load factor is given as that of the ratio of the total kilowatt hours output divided by the complete installed capacity expressed in similar units. This definition is not a fair one to use for rate making for two reasons. In the first place, the uniform rating of the output of electrical machinery is still such a cloudy affair that it should not be drawn into the controversy. In the second place, when it is used as the basis of rate fixing, it is positively unjust to the consumer. More than one instance has been known in which a central station has thus fixed the load factor and advised the consumer to install a certain size of apparatus, which many times proves larger than necessary and consequently makes the load factor appear unreasonably low, thereby an unreasonably high rate is charged the consumer.

To get right down to the fair basis, the load factor for each month should be defined as the ratio of the total output in kilowatt hours for the particular month, divided by the maximum load occurring during the month. In order that this definition should be perfectly clear, it is necessary to still further define the meaning of maximum load. In the famous Coeur d'Alene mining district where power is sold to such world-famous producing mines as the Bunker Hill and Sullivan, the maximum load is defined as that load which has the highest peak at any time during the month of at least five minutes in duration, thus eliminating instantaneous short-circuits. The Washington Water Power Company, which supplies the power to this mine, has inaugurated a system of fines and penalties depending upon peak load conditions. The fairest method, however, for the establishment of rates seems to be to take the average of ten of the highest peaks occurring on the consumer's load chart during the month.

The question of rate fixing is becoming of vital interest both to the public and the central station manager. Upon a fair and equitable basis will largely depend the attitude of the public toward the central station. Such being the case, it behooves both the public service commission and the central station owner to approach the subject with the utmost fairness and openness.

PERSONALS.

Rudolph W. Van Norden, consulting engineer, is at Portland and Seattle.

H. B. Squires, of Otis & Squires, is visiting the Eastern factories which his company represents on the Pacific Coast.

Robert Kuhn, secretary of the American Electric Heater Company of Detroit, was a recent San Francisco visitor.

R. D. Holabird, of the Holabird-Reynolds Company, has returned to San Francisco after spending the week-end at Del Monte.

R. I. B. Cleavenger, of the Phoenix Glass Company, of Pittsburg, has gone to the Pacific Northwest after visiting San Francisco.

George H. Tontrup, general manager of the American Car Company of St. Louis, is in Southern California on a tour of the Pacific Coast.

Albert Sechrist, head of the Albert Sechrist Manufacturing Company, of Denver, has been visiting the San Francisco jobbers in electrical fixtures.

J. D. Ross, superintendent of the municipal lighting department at Seattle, recently spoke on "Power Sites" at the Seattle Municipal League luncheon.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company, of Chicago, spent the past week at Portland on a business trip.

E. L. Brayton, president of the Pelton Water Wheel Company, left San Francisco for New York during the past week. He will visit the company's Eastern factory.

J. B. Lukes, who is in charge of the Stone & Webster Company's electric power interests, in Nevada, is at San Francisco from Reno, accompanied by Mrs. Lukes.

A. J. Myers, district manager for the Wagner Electric Manufacturing Company of St. Louis, has just returned to his headquarters at San Francisco from Los Angeles.

Geo. A. Dow has returned to San Francisco from England, where he obtained manufacturing rights of the Willans-Diesel engine for a plant to be erected on San Francisco bay.

W. D. Ward, representing the Pelton Water Wheel Company, is on his way to Tahiti on business connected with the installation of a hydroelectric plant in the South Sea Islands.

J. W. Grady of the Faries Manufacturing Company, of Decatur, Ill., recently passed through San Francisco, bound north on a Pacific Coast tour in the interests of his line of electric fixtures.

E. C. Meyers of Schenectady has joined the sales corps of the General Electric Company's San Francisco office, being attached to the railway supplies department. He is a graduate of Syracuse University.

John Kearns has been transferred from the position of division commercial superintendent of the Central Division of the Pacific Telephone & Telegraph Company, to that of general superintendent of collections.

F. F. Foster, formerly sales manager with B. F. Kierulff & Company, has opened business for himself and will handle an extensive line of electrical and industrial equipment, with headquarters at Los Angeles, Cal.

H. E. Sanderson, Pacific Coast manager for the Bryant Electric Company, is visiting Seattle and will later attend the annual sales conference of the Northern Electric Manufacturing Company, at Vancouver, B. C.

J. A. Balch, president of the telephone company at Honolulu, arrived at San Francisco during the past week, accompanied by Mrs. Balch. They are returning to the Hawaiian Islands after making a tour of this country.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, is on his way to Japan on the steamer Mongolia. He will return on the Siberia after enjoying a few weeks of well-earned recreation.

Charles Mallory has resigned as an instructor in the engineering department of the University of Washington to join the Stone & Webster engineering force which is installing the Big Creek plant of the Pacific Light & Power Corporation, near Fresno, California.

Geo. A. Damon of the B. J. Arnold Company, at Los Angeles, will deliver an illustrated address on "The Fundamentals of a Comprehensive Transit Plan," at the annual public meeting of Tau Beta Pi at the University of California, on the evening of April 23, 1912.

J. W. Gilkyson, commercial superintendent of the Pacific Telephone & Telegraph Company at Los Angeles, has been transferred to San Francisco, where he will have the same title in the Central Division. Charles F. Mason, the former district superintendent, succeeds him at Los Angeles.

A. H. Babcock, chief electrical engineer of the Southern Pacific Company, left for Portland last Sunday morning in his private car, having as his guests Gano Dunn, president of the American Institute of Electrical Engineers, and Ralph W. Pope, the honorary secretary. They went north to attend the annual convention of the Institute at Portland.

W. P. L'Hommedieu and **R. F. Behan** of the Westinghouse Electric & Manufacturing Company's San Francisco office, recently addressed the association of electrical engineering and mechanical engineering students at the University of California at Berkeley. The subject was the apprenticeship system at the company's East Pittsburg works. Stereopticon views were shown.

Elam Miller, who was widely known on the Pacific Coast as commercial engineer with the Pacific Telephone & Telegraph Company, has succeeded Dr. Frank J. Jewett as transmission and protection engineer of the American Telephone & Telegraph Company, with headquarters in New York. Dr. Jewett becomes the assistant chief engineer of the Western Electric Company.

H. P. Pitts, of the new business department of the Pacific Gas & Electric Company, was the guest at the Home Industry League's luncheon at the Palace Hotel last Thursday, and he delivered an address illustrated with stereopticon views. He explained a number of the new gas and electrical devices that are being introduced by his company for use in homes and in industrial establishments.

G. W. Canney, manager of the service department of the Westinghouse Electric & Manufacturing Company, with headquarters at East Pittsburg, arrived at the San Francisco office of the company during the past week. He is on one of his periodical tours of the country and will spend about two weeks here for the benefit of the local branch of his department, which has to do with erection and repair work.

Sidney Sprout, engineer for the California-Oregon Power Company, has returned to San Francisco from Portland, where he secured for his company a three-year lease of the Klamath Lake Railroad. This road, which extends from Thrall, on the Southern Pacific, to Pokegawa, will be used for hauling the machinery and construction materials that are to be used at the California-Oregon Power Company's new hydroelectric development on the Klamath River about twelve miles from Thrall.

PACIFIC COAST N. E. L. A. TRAIN DE LUXE.

Arrangements are being completed for a special train de luxe for the accommodation of all Pacific Coast electrical men desiring to attend the thirty-fifth annual convention of the National Electric Light Association at Seattle, June 10-13.

The Southern Pacific Company will offer rates for the round trip of approximately $61, from Los Angeles, and $45 from San Francisco. The train from Los Angeles will leave that city on Friday evening, June 7th, reaching San Francisco on Saturday morning, June 8th, when the train will start for Seattle, arriving there Sunday evening, June 9th.

The convention will open on Monday morning and at its close the train will return to San Francisco. Accommodations may be engaged for both the going and coming trip. Reservations are now being made at the office of the Journal of Electricity, Power and Gas. To every electrical man in the West who plans to attend this convention, we will be pleased to furnish full details upon request.

SEATTLE JOVIANS.

On April 11 Mayor Cotterill addressed the Jovian Electrical League, the local branch of the Rejuvenated Sons of Jove, at a noonday luncheon at the Hotel Washington Annex, where an attendance of 125 testified to the remarkable growth that has been made in Seattle. A. S. Barlow was chairman of the entertainment committee and A. E. Knoff toastmaster. Mayor Cotterill spoke of his trip to the Hebb power site, describing the property offered to the city and its possibilities for furnishing additional power to the city. He said that from an engineering standpoint and from the standpoint of public policy Seattle should develop all the water power propositions in that vicinity in order to bring down power rates. He also said that it was possible to develop, with the present flow of water at the White River intake of the Hebb property, 25,000 continuous horsepower with but little construction work, and that with an impounding dam 40,000 horsepower could be obtained. The mayor commended the members of the order for their "get together" spirit to advance the interests of electricity.

TRADE NOTES.

The Habirshaw Wire Company announces the removal of its offices in New York City to the 27th floor of the Metropolitan Tower.

The Union Tool Company of Los Angeles has purchased from the Allis-Chalmers Company, a 500 kw. steam turbine generator set, with switchboard, etc.

The Vix Engineering Company, Mills Building, San Francisco, have been appointed the Pacific Coast representatives of the Wisconsin Engine Company and will handle their crude oil gas producers and gas engines.

The Benjamin Electric Manufacturing Company has added to its sales force Mr. A. E. Lubeck who will travel in the Central States with headquarters in Chicago. They have also secured the services of Mr. Otis L. Johnson, formerly with the National Lamp Association, who will have charge of the illuminating department.

The recent monthly dinner of the principal men connected with the General Electric Company's San Francisco office, was held at the Techau Tavern, with Tracy E. Bibbins, the local manager, presiding. There was a large attendance, including most of the local men and H. E. Plank, of the Portland office. Stanley A. Walton, of the Pacific Gas & Electric Company, made a very instructive address on the operation of and results obtained from the demonstration car which his company sends all over the State to show practical application of electrical devices.

Among the recent orders received by the Westinghouse Electric & Manufacturing Company are the following: From the East Shore & Suburban Railroad, Oakland, Cal., one 1500 kw. motor-generator set, consisting of a 10,000 volt, 60 cycle, synchronous motor and a 600 volt direct current generator. From Stone & Webster for the Seattle Electric Company, Seattle, Washington, two 1500 kw. motor-generator sets, delivering 250 volts, direct current for operation on a three-wire system. The motors are three-phase, 13,200 volts, synchronous type. Oakland & Antioch Railroad Co., Oakland, Cal., has ordered a 750 kw. motor generator set consisting of 11,000 volt synchronous motor and a generator delivering direct current at 1300 volts. This set is of particular interest owing to the fact that it generates direct current at this high voltage.

MEETINGS OF PACIFIC COAST A. I. E. E. SECTIONS.

On Thursday evening, April 11th, the Los Angeles section of the American Institute of Electrical Engineers held a largely attended and enthusiastic meeting, the principal speaker being Mr. Gano Dunn, president of the Institute. A number of matters of importance were discussed, Mr. Dunn describing in detail the plan for a new distribution of the membership of the Institute. On Saturday, members of the section were invited by the Edison Company and the Pacific Light & Power Company to accompany Mr. Dunn on a visit to their respective steam generating plants at Long Beach and Redondo. The Pacific Electric Railway placed at their disposal an observation parlor car and at 9:15 a. m. 22 of the members and guests pulled out for Redondo. After visiting the Redondo plant, the car was run back to Watts and then down to San Pedro, where the new harbor was shown to Mr. Dunn. From here the short run to Long Beach was made and the new Edison plant was thoroughly inspected. From Long Beach the return to Los Angeles was made. A buffet lunch was provided on the car and everybody had a good time. Those present were: Messrs. Gano Dunn, J. A. Lighthipe, S. H. Anderson, R. W. Sorenson, A. Kean, Geo. A. Damon, F. Dix, C. W. Koiner, E. L. Veuve, Edward Woodbury, Jas. M. Gaylord, E. R. Northmore, E. R. Davis, R. H. Manahan, Jos. E. Barker, K. E. Van Kuren, Geo. L. Hoxie, Rudolph W. Van Norden, Henry S. Carhart, Leo Keller, S. J. Keese, J. E. MacDonald.

The San Francisco Section of the A. I. E. E. had the pleasantest gathering of the year on Saturday evening at Tait's Cafe in honor of Gano Dunn, president of the Institute. Forty members were present to do homage to their chief. S. B. Charters, chairman of the section, called upon C. L. Cory for a few remarks. Mr. Cory then traced the history of western power development, ending by alluding to the brilliant future ahead in the opening of the Panama Canal. S. J. Lisberger, John Martin and H. A. Lardner also spoke feelingly of western prospects. Gano Dunn and Ralph W. Pope, the venerable honorary secretary of the institute, closed the interesting series of talks. Mr. Dunn went into great detail in telling of his experiences in finally securing the international electrical congress for 1915.

The necessity of passing the amendments now before the institute was urged by Mr. Dunn, who presented convincing arguments for favorable action. With but one exception all the branches and sections of the institute, which have acted, have done so affirmatively. All western members should aid in this good cause by returning an early affirmative ballot.

The date of the April meeting of the Seattle Section has been changed to Tuesday evening, April 23d, at 8 o'clock, in the assembly room of the Chamber of Commerce, Central Building. Mr. Ralph W. Pope, honorary secretary of the institute, will be in the city that date and talk on the institute work. Mr. E. M. Hewlett's paper, "Characteristics of Protective Relays," which was published in the March Proceedings, will be taken as the subject of the meeting. Mr. J. Harisberger, of the Puget Sound Traction, Light & Power Company, will present a discussion with reference to relays on transmission lines. Mr. R. F. Monges of the General Electric Company, will discuss their application to electric drive and industrial power installations. Mr. S. C. Lindsay, of the Seattle Electric Company, will discuss the use of relays in connection with overhead and underground distribution networks. The Westinghouse Company will have an engineer present to discuss their characteristics and special adaptations.

EXAMINATION FOR DRAFTSMAN.

An examination will be given at Mare Island Navy Yard on April 29th, 1912, for one second class marine engine and boiler draftsman at $4.72 per diem.

INDUSTRIAL

BATTERY SWITCHES IN GANG TANDEM.

The Cutler-Hammer Battery Switch has heretofore been furnished standard as a single switch or in gangs of two, three and four with plates to suit. However, in some cases recently there has been a desire to mount the switches one above the other and for this reason the Cutler-Hammer battery

Cutler-Hammer Battery Switches.

switches are now furnished in gangs side by side and one above the other as shown in the illustration. The switches in both cases are the same, 10 ampere, 80 volt battery type arranged for push and pull operation—pushing the button opening the circuit. The frames of the individual switches are riveted to a steel connecting link. A solid flush plate, polished brass, brush brass, polished nickel or gun metal finish, is fastened with machine screws to the switches after they are installed.

AN ELECTRO-MAGNETIC AFTER-DINNER SPEAKER.

As a general rule, after-dinner speeches can successfully compete with so-called sleeping powders in their slumber-producing effect, unless some novelty is brought into play or some unusually eloquent or witty speaker is heard. Either alternative is difficult to find, but it has remained for the telephone to create a new interest in "we-have-with-us-tonight" oratory.

Members of the Yale Club, residing in Chicago, recently decided to hold a dinner at the Hotel Blackstone and naturally wished to hear a personal message from President Hadley of their alma mater. As it was not convenient for the latter to attend the dinner, and the committee thought that a letter would not convey the same spirit of warmth and good cheer, it was decided to see what the long distance telephone could do to bring about the desired result. What would have been considered an utterly foolish idea a few years ago was a comparatively simple thing for the present-day telephone engineer.

As the result of special arrangements made by the Chicago Yale Club, two direct wires were connected through from President Hadley's home in New Haven, Conn., to the Hotel Blackstone, Chicago, with a telephone repeater at the latter point, in order that no word of the speaker's remarks might be lost. The diners, seated in groups of eight at small tables, listened through Western Electric watch-case receivers to a most interesting five-minute speech, beginning at about 9:17 p. m. Having finished speaking, President Hadley took up a receiver on the second or listening circuit and for over half an hour listened to the songs and cheers of the merry gathering.

To President Hadley, therefore, belongs the unique distinction of having made the longest long-distance speech on record. The vista of possibilities opened up by this achievement are enormous, to say nothing of the transportation expenses saved in bringing noted speakers to the place of meeting.

WESTINGHOUSE LOCOMOTIVES FOR THE SOUTHERN PACIFIC COMPANY.

Six direct current 60 ton Baldwin-Westinghouse electric locomotives and 20 Westinghouse car equipments with HL control have been purchased by the Southern Pacific Railroad Company for operation on the Southern Pacific and the Pacific Electric Company properties. Both the car and locomotive equipments are arranged for operation on either 600 or 1200 volts. Most of the property now operates at 600 volts, but there are portions at 1200 volts, and the double voltage equipment was selected so that it might be used on any portion of the system and on such 600 or 1200 volt extensions as may be built in the future.

The 60-ton locomotives, each of which will have an aggregate motor capacity of 1000 h.p., will be the largest 1200 volt locomotives ever built. They will have quadruple equipments of the No. 308-B-7 commutating pole motor which is a 600-1200 volt motor rated at 225 h.p. at 600 volts with natural ventilation and 250 h.p. at 600 volts with forced ventilation. This motor has all the exclusive features of Westinghouse railway motor construction, such as spider armature construction, bolted commutator, rugged brush holders and oil and waste lubrication that have made Westinghouse railway motors famous.

Because of the large capacity of the motors the duty on the control equipments will be very severe. Westinghouse HL Control which has already demonstrated its fitness for controlling motors of great capacity on the Pennsylvania locomotives will be used. Mechanical parts for the locomotives will be furnished by the Baldwin Locomotive Works. The cabs and frames will be entirely of steel.

A Westinghouse dynamotor-compressor will be used on cars and locomotives for operating the air compressor and for furnishing 600 volt current for both control and lights when the equipments is on 1200 volt sections of the line.

The 20 passenger cars will be furnished by the Pullman Palace Car Company. Each car will have quadruple equipments of Westinghouse No. 327-C Commutator pole, 50 h.p. (at 600 volts) meters and Westinghouse HL control.

TRADE NOTES.

An order for three quadruple equipments of 101 B-2 motors and K-28 B control has just been received by the Westinghouse Electric & Manufacturing Company from the Boise Railway Company, Boise, Idaho.

R. E. Starkweather, transmission line specialist is building 80 miles of double circuit steel tower line from Colton to Long Beach under contract from the Southern California Edison Company. He also has to string double circuit 0000 aluminum wire on the new 240-mile steel tower line of the Southern Sierras Power Company from Bishop Creek to San Bernardino.

NEWS NOTES

INCORPORATIONS.

LONG BEACH, CAL.—The California Co-Operative Motor Company has been organized here with a capital stock of $150,000. The company will erect a building to cost between $40,000 and $60,000. The directors are: W. H. Bennette, Joseph J. Mottell and Stephen H. Underwood.

VANCOUVER, WASH.—The Independent Electric Company, capital stock $50,000, has filed articles of incorporation. The incorporators are H. G. Fleischhauer and M. F. Brady, of Portland, and H. K. Lugger, of Vancouver. The principal place of business is Vancouver, though an office may be retained in Portland.

SAN DIEGO, CAL.—Articles of incorporation have been filed for the El Cajon Valley Homeland Water Company, with capital stock of $15,000. J. F. Cullen, C. N. Woodworth and C. C. Tolstam are the directors. The company is formed for the purpose of acquiring the necessary rights of way for pipe lines, flume lines, aqueducts, reservoirs, and for storing and carrying water from some point on pipe lines of San Diego Flume Company to El Cajon Valley Homeland Tract.

ILLUMINATION.

OXNARD, CAL.—Oxnard has voted $100,000 bonds for a water plant and $30,000 bonds for a lighting system.

CULDESAC, Idaho.—The City Council is considering bonding the town for putting in an electric light plant and possibly taking over the waterworks system.

VALLEJO, CAL.—An ordinance is in readiness calling for an election to be held on May 15th, on the proposition to bond the city for $100,000 for a municipal light plant.

SHELTON, WASH.—The Peninsular Railway Company has been granted the right to use the streets and alleys of the town of Shelton for the purpose of transmitting heat and light within said city.

SANTA ROSA, CAL.—Notwithstanding the fact that it lost the franchise it had applied for and which was sold to Fred L. Wright, the Great Western Power Company has applied to the Supervisors for another franchise.

SPOKANE, WASH.—The Spokane, Washington Improvement Company, owners of the Rockwood addition, are opening negotiations for the installing of artistic electroliers on all the boulevards and cross streets and avenues in the addition. The improvement will represent a cost of $15,000 to $20,000.

SEATTLE, WASH.—Four bids for supplying the city lighting department with 58,000 incandescent lamps for the ensuing year were received and all were for exactly the same amount, $84,539.20. The Board of Public Works awarded the contract to the Northwest Electric & Supply Company, a local concern.

WALLA WALLA, WASH.—Bids for material for a new $30,000 gas plant in this city to be erected by the Pacific Power & Light Company, have been called for by Chief Engineer McGee, with headquarters in Portland and as soon as the various bids are submitted and passed upon actual work will be started. It is to be a two-story brick building at Sixth and Rose streets.

LINDSAY, CAL.—An application has been made to the Board of Trustees for a franchise of 50 years, for the purpose of conducting and distributing electricity and electric power for heating, lighting and power purposes in the city of Lindsay. Sealed bids will be received up to April 23, for the sale of said franchise to the highest bidder. Each bid must be accompanied by a certified check in full amount of bid, payable to the treasurer of the city.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company's earnings for three years compare as follows:

	1909.	1910.	1911.
Gross	$13,491,288	$14,044,596	$14,604,609
Operating expenses	7,531,576	7,921,341	8,214,071
Net earnings	5,959,712	6,123,255	6,390,537
Bond interest	2,988,522	3,006,256	3,254,133
Balance	2,971,190	3,116,999	3,136,404

PORTERVILLE, CAL.—New officers for the Home Gas Company were elected at a meeting of the board of directors Saturday. The reorganization of the old corporation is one of the steps in the final development of the Central Counties Gas Company, now under way. New officers, as selected for the company, include: Charles S. S. Forney of Los Angeles, president; E. E. Graham, a local banker, vice-president; H. B. Landis of Los Angeles, secretary; E. J. Broberg of the Pioneer Bank of this city, treasurer, and J. H. Strades of Los Angeles, director. President Forney announced that within a week they would have an expert on the ground to reconstruct the distribution system, after which they will lay a gas main from here to Lindsay, a distance of 14 miles.

PORTLAND, ORE.—An ordinance giving the Northwestern Electric Company of Portland and San Francisco a 25-year franchise to engage in the business of distributing electricity to the people of Portland for light, heat and power purposes, has been presented to the City Council. The terms of the proposed grant provide for the payment to the city of a percentage of the company's gross earnings within the city, and specify the rates that shall be charged. The Council is given power to regulate the exercise of the franchise. It is agreed that construction work inside the city limits is to begin within one year following the passage of the ordinance and that at least 10,000 horsepower of electricity will be ready for delivery in two years. The company must deposit a $50,000 bond which shall be void after $250,000 has been expended in construction work, 20 per cent of which is to be spent in the city. The balance will be expended in the development of its hydroelectric power plants on the Klickitat, Lewis and White Salmon Rivers. If, at the end of 25 years, two-thirds of the voters elect that the city acquire the plant a sale will be made on a valuation to be fixed by arbitration. The incorporators are: Mortimer Fleishhacker, president of the Great Western Power Company, and the City Electric Company of San Francisco; Herbert Fleishhacker, president of the Anglo & London-Paris National Bank, of San Francisco; William H. Crocker, of the Crocker Real Estate Company and the Crocker National Bank, of San Francisco; Antoine Borel, of Antoine Borel & Co., San Francisco bankers; the Daniel Meyer Bank, of San Francisco, and others. The company already has started the construction of a 15,000 horsepower hydroelectric plant on the White Salmon River. Part of this energy is to be utilized to operate the Camas paper mills, which now run by steam power from oil-burning boilers. Stone & Webster have charge of all construction work and B. C. Condit is resident engineer for the company.

TRANSMISSION.

PENDLETON, ORE.—John T. Whistler, engineer, submitted his report on the power site on the Walla Walla River upon which the city has an option and which is proposed as the source of supply for a municipal power plant; $55,000 is the approximate amount which he figures would be neces-

sary for a transmission line from the power plant to Pendleton and for a distribution system for the city.

CALDWELL, IDAHO.—The interests of the old Caldwell Power Company have been taken over by the Idaho-Oregon Light & Power Company. Several minor extensions are planned by the new company.

SALEM, ORE.—The Southern Pacific has filed with the State an application to appropriate the waters of the McKenzie River at Cedar Lake. It is reported that the company will build a power plant on the site.

BAKER CITY, ORE.—J. A. Howard has been granted a franchise for the construction and maintenance of a power line from the Swan Falls plant to Mormon Basin. Several large mining companies will be furnished power.

LOS ANGELES, CAL.—The Board of Public Works has authorized preliminary steps to be taken relative to installation of a municipal power distributing system. President Hubbard and Commissioner Humphreys of the board estimate that it will cost about $25,000 to make the maps desired. At a conference it was decided that a bond issue would be necessary, but the election, it was argued, should be held in January instead of December, as first proposed.

SACRAMENTO, CAL.—The Great Western Power Company, through its attorney, appeared before Superior Judge Shields to show cause why a restraining order should not be issued by the court preventing it from operating a power plant line underneath the sidewalk in front of the Clunie building. Mrs. Florence Clunie in a suit filed recently asked for such a restraining order. The case is an important one of State-wide interest. It involves the ownership of the area underneath the sidewalk. The question has never before been raised in the State, and upon its outcome may depend similar actions all over California.

FRESNO, CAL.—A complete appraisal of the physical property of the San Joaquin Light & Power Company will be made by J. G. White & Co., Inc., of New York and San Francisco. Beginning on April 15 the work of valuing the properties of this big public utility corporation will extend over a period of several months and engage the attention of a staff of 35 to 40 engineers and real estate experts. The work will be under the general direction of J. C. Gillespie, manager of the valuation department of J. G. White & Co. on the Coast, who will open a temporary office in Fresno for the convenience of the field force.

SALEM, ORE.—Power development, for which it is estimated $5,149,515 will be expended, is represented in filings allowed by the State Engineer's office, according to an abstract just completed by State Engineer Lewis. The office has issued 124 permits representing a total of 116,340 horsepower, or an average of 922 horsepower for each filing. The largest filing shown by the abstract was made by W. K. Brown, on the Klamath River, for 20,000 horsepower. The next largest filing was by the Willamette Power Company, of Portland, on the North Fork of the Santiam River. These two represent 10,200 horsepower. D. P. Donovan of Payette, Idaho, asks for 1200 cubic second feet from the Clackamas River between Oregon City and Portland. It is presumed he intends to develop power for use in Portland, as the application says that it will be used for power, manufacturing and municipal purposes. According to application, the cost of developing power will be $1,250,000. It is intended to develop 15,000 horsepower and construct two pipe lines five and one-fourth miles long. Fees amounting to $818 were paid by Donovan.

TRANSPORTATION.

NORTH YAKIMA, WASH.—It is reported that the Kittitas Railway & Power Company, now constructing a line from Cle Elum to Roslyn, will extend the line here.

KALISPELL, MONT.—The Flathead Interurban Railway Company has made application for a franchise to use certain of the streets in Kalispell for a street railway system.

NEW WESTMINSTER, B. C.—The British Columbia Electric Railway Company will soon make a tentative survey for an extension on from here to Delta. It is believed the road will be built shortly.

TULARE, CAL.—David Oliver Jr., and H. W. Coffin, both of San Francisco, have announced that they are preparing to take up the construction of the Porterville-Tulare Electric Railroad, which has been under discussion for the past half a dozen years.

SACRAMENTO, CAL.—Because of the increased traffic between Stockton and Sacramento the Central California Traction Company has determined hereafter to run two-car trains between the capital and the channel city. Heretofore single interurban cars have been on the run. The two-car trains will be a permanent thing after next Sunday.

SACRAMENTO, CAL.—The Central California Traction Company, which runs an electric line from Stockton to Sacramento, has appeared before the State Railroad Commission, through its attorneys, pleading for an order commanding the Santa Fe road to establish with it joint rates, through, and local, passenger and freight. Because of the insufficiency of the evidence as submitted and in order to give attorneys for both sides longer time to prepare additional evidence in the case, the hearing was postponed until April 26.

SAN FRANCISCO, CAL.—The last $400,000 of 4½ per cent Geary street railway bonds have been sold to Adams & Company of Boston, for $402,064 and accrued interest. The city received a premium of $2064 on the block. Adams & Company's bid was submitted through the Bank of California. The bid was authorized by a certified check for $10,000 from the bank. One other bid was received, this being the offer of Vincent D. McDevitt of this city to purchase one $1000 bond at par. Delivery of the bonds will be made immediately.

LOS ANGELES, CAL.—The steel gang of the Pacific Electric Railway Company which is broad-gauging the old interurban line, has completed the track to the planing mill of the San Pedro Lumber Company. Work of resurfacing the track up to this point now will be taken up. About two weeks later an extension of the broad-gauge track will be made into the business district. It is likely that this will be done by following the low ground north of Nob Hill through an intersection with a line from Dominguez. The route will be double-tracked south from Athens at an early date.

SAN FRANCISCO, CAL.—New bids for the construction of the Geary street road from Fifth avenue to Kearny street have been asked by the Board of Public Works. Spurred on by the Mayor, the commissioners have decided to go ahead with the Geary street road work as rapidly as possible and will open bids next Wednesday afternoon. Bates, Borland & Ayer, who submitted the lowest bid for the road building and who were awarded the contract but have refused to enter into an agreement with the Board of Public Works, are seeking to restrain the board from declaring forfeited their certified check for $25,000.

VISALIA, CAL.—The Tidewater & Southern Railway, now in course of construction, between Stockton and Turlock, is to be extended through the Alta section of Dinuba to Visalia. The new electric railway is under contract to be in operation into Turlock by July 4 and into Fresno by January 1, 1913, so that Visalia is expecting to see trains running to this city in less than a year. It is the plan of the road to run from Fresno south through Selma to Dinuba, thence through Orosi and Yettem to Visalia, and from this city south to Tulare, thence east to Lindsay and Porterville and south to Bakersfield, the present terminus.

MARYSVILLE, CAL.—Work is progressing satisfactorily on the construction of the Northern Electric's branch road from Marysville to Colusa, and representatives of the company declare that at the present rate of progress cars will be running into Colusa before the end of the year. Already much of the grading has been done between Terra Buena, which will be the junction with the main line, and Meridian. Four grading camps have been established along this section. The work in the vicinity of Sutter City has been completed, and on Saturday night the camp moved farther toward the Sacramento River.

SAN FRANCISCO, CAL.—That the United Railroads Company is about to erect a building at the corner of Market and Valencia streets, was vouched for Monday in connection with the announcement of the sale of real estate in the same block facing Market street. This information was to the effect that the company will build a structure of three stories, covering a large area. The ground floor is to be designed for a street railway terminal, into which several lines will converge, so that it will be similar in several respects to the Pacific Electric terminal building in Los Angeles. The second story will be used for offices of the corporation, and the third floor for club-rooms for the employes. It was said that upon the strength of this report the contiguous real property was purchased as an investment at a price approximating $1000 a front foot, the frontage being 84 feet, and the price, including commissions, $85,000.

TELEPHONE AND TELEGRAPH.

UKIAH CITY, CAL.—Jerry Lierly has been granted permission to erect and maintain a telephone line.

ALTURAS, CAL.—The Leland & Myers Corporation have been granted permission to construct and maintain a system of telephones from Alturas to Round Valley.

SANTA MONICA, CAL.—The Pacific Telephone Company will start work within 30 days on an $18,000 job of laying a cable from city city to Venice, to carry wires.

MENDOCINO, CAL.—A franchise has been granted F. M. Weber and Dr. Peirsol for a telephone line from this place to East Mendocino and it is the intention to put in the line in the near future.

SAN FRANCISCO, CAL.—Three affidavits have been filed with the Superior Judge by Attorneys Crist and Johnson in support of their contention that the Bay Cities Home Telephone Co. and Pacific Telephone & Telegraph Co. were violating the terms of the restraining order temporarily granted by Judge Lawlor forbidding the dismantling of the phones and apparatus of the Home Company. One of the affidavits was filed to refute the claim that O. L. Scott, plaintiff in the injunction matter was in arrears to the telephone company in the payment for phone rentals. Lewis W. Ross, an affiant, declares that subsequent to March 23 there were 65 Home telephones disconnected, and appends to his affidavit a list of the subscribers whose phones he alleges were disconnected.

WATERWORKS.

MONMOUTH, ORE.—Bids will be received up to the 4th day of May, for furnishing the material and labor for constructing a system of waterworks.

OXNARD, CAL.—By a vote of 4 to 1 citizens of Oxnard authorized a bond issue of $130,000; the fund is to be divided, $100,000 going to the water plant and $30,000 for a municipal lighting system.

LOS ANGELES, CAL.—Construction work on the new plant in connection with the Mutual Water Company, which is to supply water to half-acre subdivisions on the Cudahy ranch, will be started at once.

AUBURN, CAL.—If Auburn's water consumers will agree to the meter system and reduce their water consumption from 750 gallons per day per capita to 150, the Pacific Gas & Electric Company, according to H. P. Lensomo, will install a $70,000 filter system.

SANTA BARBARA, CAL.—A resolution has been drawn ordering the sale of waterworks extension tunnel bonds in the amount of $39,000, thirty-nine in number, of $1000 each, bearing 4½ per cent interest, payable semi-annually. Bids for the bonds will be received up to 8 o'clock, May 2, and must be accompanied by a certified check of $4000.

OAKLAND, CAL.—City Water Expert J. H. Dockweiler has filed with the City Council his bi-monthly report of the operations of the People's Water Company during the months of January and February. The report shows the following: Disbursements—Expenses, $40,651.21; supply, $4724.39; distribution, $14,762.50; maintenance, $2788.78; renewal, $154.23; general expenses, $16,033.48; service construction, $2187.83. Investment—Construction account, $8347.96.

RIDDLE, ORE.—The contract for the city's new water system has been awarded to Kibbe-Welton Co., a Portland firm, for $11,454.58. The water supply is to be brought from Wilson Creek, about 3½ miles to a reinforced concrete reservoir of 100,000 gallons capacity. The concrete dam is to be placed in Wilson Creek at the intake. The engineering work is to be done by C. C. Boyer and Frank Cain of this city.

ALTURAS, CAL.—Officials of the newly-organized Modoc Irrigation Company have arrived here to prepare for the tapping of Cowhead lake, which will furnish power and light for the towns of this county and also irrigate thousands of arid acres in the famous Surprise valley. The project involves an expenditure of $500,000 and the promoters claim it will be one of the most profitable enterprises in the State. Eventually a broad-gauge railroad will be built into the valley.

OAKLAND, CAL.—In accordance with the provisions of the city charter and the repeated demands of the City Council, the Union Water Company has filed its report with the city clerk. It shows the following properties in actual use for water distribution in Oakland: Plants at Toler Heights, valued at $3500; Fremont Heights, $1000; Stonehurst, $1000; Elmhurst, $8000. Total number of meters paying $1.50 minimum rate, 421; supplied 392,952 cubic feet last year. Total pumpage, 52,820,074 gallons last year. Total services, 1380. Total number of meters in use, 1379.

SALEM, ORE.—Presumably for the purpose of securing power to electrify the main and west-side lines in this State, the Southern Pacific Railway Company has filed with State Engineer Lewis an application to appropriate the waters of the McKenzie River. The application calls for the appropriation of 400 cu. ft. per second and the diversion of the water of Clear Lake through a canal 4½ miles long, generating 36,136 theoretical horsepower, utilizing a fall of 795 ft. The dam is to be 31 ft. high, costing approximately $85,000 and the total cost is estimated at $1,600,000.

RED BLUFF, CAL.—The estimate made by City Engineer W. F. Luning for a complete water system for the city of Red Bluff places the cost at $85,325. This estimate was made upon instructions given the city engineer at the February meeting of the board to make an estimate of the cost of such a plant. At the same time the engineer was instructed to make an estimate of the cost of installing a lighting system for the city. Mr. Luning reports that the cost of the lighting plant, including water rights, power and everything else necessary, will be $146,668. The water plant of the Antelope Water Company, which now furnishes the town with water, is offered by the company to the city for $123,000, or for a sum $37,675 in excess of the sum that the new and modern plant is estimated to cost.

ALPHABETICAL INDEX TO ADVERTISERS

Allis-Chalmers Co.
Aluminum Company of America
American Bridge Company
Benjamin Electric Manufacturing Company 13
Blake Signal & Manufacturing Company 11
Bonestell & Company 5
Bridgeport Brass Company 4
Brill Company, The J. G.
Brilliant Electric Company
Brooks-Follis Electric Corporation
Buckeye Electric Company, The
Century Electric Company 5
Colonial Electric Company
Colonial Electrical Agency Company
Crocker-Wheeler Company 5
Cutler-Hammer Mfg. Co.
D. & W. Fuse Company
Dearborn Drug & Chemical Works 12
Duncan Electric Manufacturing Company
Economy Electric Company
Electric Storage Battery Company
Electrical Engineers' Equipment Company
Farnsworth Electrical Works
Farrar & Company, J. C.
Fibre Conduit Co., The
Fort Wayne Electric Works 2
Fostoria Incandescent Lamp Co.
General Electric Company 14
Gould Storage Battery Company
Habirshaw Wire Company
Hammel Oil Burner Company
Hemingray Glass Company 16
Holophane Company
Hughes & Company, E. C. 12
Hunt, Mirk & Company
Indiana Rubber & Insulated Wire Co.
Johns-Manville Co., H. W.
Kellogg Switchboard & Supply Co.
Kelman Electric & Manufacturing Co. 4
Klein & Sons, Mathias 12
Leahy Manufacturing Co.
Locke Insulator Manufacturing Co. 4
Lombard Governor Co.
McGlauflin Manufacturing Co.
Moore & Co., Engineers, Chas. C.
Multiple Arch Hydraulic Construction Company, Ltd.
National Metal Molding Company 16
New York Insulated Wire Company
Nuttall Company, R. D.
Ohio Brass Company
Okonite Company 16
Pacific States Electric Co. 16
Pelton Water Wheel Company 5
Pierson, Roeding & Company 4
Pittsburg Piping & Equipment Company 16
Safety Insulated Wire and Cable Co. 3
Schaw-Batcher Company Pipe Works, The 1
Southern Pacific Company 13
Sprague Electric Works 5
Standard Underground Cable Company 16
Stewart Fuller Co.
Tracy Engineering Company 13
Thomas & Company, R.
Western Electric Company
Westinghouse Machine Company 6
Westinghouse Electric & Manufacturing Co.
Weston Electrical Instrument Company 3
Wilbur, G. A.

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